The woollen mill and foundry at Yarker. *Manly MacDonald, R.C.A.*

DEPARTMENT OF PLANNING AND DEVELOPMENT

HON. W. M. NICKLE, Q.C.
Minister

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Deputy Minister

A. H. RICHARDSON
Chief Conservation Engineer

NAPANEE VALLEY CONSERVATION REPORT 1958

SUMMARY

TORONTO
1958

INTRODUCTION

The Napanee Valley Conservation Authority was established by Order-in-Council on November 20, 1947, following an organization meeting which was held at Napanee on October 23, 1947. At the request of the Authority, the Department of Planning and Development agreed to carry out a conservation survey of the valley for the guidance of the Authority. The commencement of conservation work, however, in an Authority does not necessarily have to wait until such a survey has been made and the report presented. This has been the case with the Napanee Conservation Authority, and much excellent work and planning had been done before this report was presented. For example, the Authority has already acquired 4,379 acres of land for its Authority Forest and has constructed the Second Depot Lake Dam.

The Napanee Valley Conservation Report, 1957, covers the subjects of History, Land, Forests, Water and Wildlife, and was presented to the Authority on October 31, 1957, by the Honourable W. M. Nickle, Q.C., Minister of Planning and Development. Two hundred copies were mimeographed, as a working plan for the Authority members and other officials. This summary of the large volume, to the number of 3,000, is for distribution to the people of the valley.

A. H. Richardson

Napanee Valley Conservation Authority

Established November 20, 1947

Chairman	G. A. GRANT, Verona
Vice-Chairman	A. GRAHAM, Selby
Chief Officer	A. H. RICHARDSON, Toronto
Secretary-Treasurer	C. H. KNIGHT, Napanee
Field Officer	M. CHUBB, Cannifton

MEMBERS:

Bedford Township	C. BARR
Camden East Township	*N. KENNEDY
Ernestown Township	*F. E. HUFF
Fredericksburgh North Township	H. L. PRINGLE
Hinchinbrooke Township	W. A. GOODFELLOW
Loughborough Township	J. F. DEYO
Napanee Town	*A. D. ALKENBRACK
Newburgh Village	*W. WAGAR
Portland Township	*G. GRANT
Richmond Township	*A. GRAHAM
Sheffield Township	V. J. BURNS

*Member of Executive Committee

CONSERVATION BRANCH

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Recommendations

Stated or Implied in This Report

HISTORY

1. That, before carrying out any project, the Authority ascertain from the Royal Ontario Museum of Archaeology at Toronto, or from the appropriate department of Queen's University at Kingston, whether the area concerned is likely to contain archaeological material, and, if necessary, arrange for the investigation of the site before operations make this difficult or impossible.

2. That where records, buildings and objects exist of sufficient interest as illustrating the life of the watershed during the period of development, the preservation of these relics be considered an aspect of conservation; and that where such records and other relics are the private property of individuals and corporations within the watershed, the Authority take definite measures to encourage their preservation by their owners, or by their commitment to proper care in libraries, museums, archives, and other suitable repositories.

3. That when sites, buildings, or ruins of structures, of this kind, form part of, or are adjacent to, properties acquired by the Authority for flood control, reforestation, or recreation, the possibility of including them in the scheme be considered.

4. That in such cases sites be marked, ruins preserved, and buildings restored and used for some purpose in connection with the project compatible with retaining their original character.

5. That the Authority appoint a Historical Sites Advisory Board to make recommendations to it with regard to matters of historical interest, including the preservation of historical buildings and relics.

6. That from the large number of sites and buildings of historic interest (in the wider sense used in these recommendations) to be found within the watershed, a few be selected for inclusion in the scope of the activities of the Authority, besides those connected with recommended projects.

7. That this selection include the sites of the mills known to have been in operation before 1840, as well as the sites of early schools, churches, and other buildings of historical interest that have been destroyed, and some existing buildings interesting for their associations or age.

8. That a survey be carried out, so far as possible in co-operation with other organizations and individuals engaged in the study of local history, to ascertain what objects of historical interest exist in the watershed, and to consider how some of these may be preserved.

9. That, wherever possible, the buildings be left on their original sites and continued in their original use, or adapted to some suitable purpose in connection with the normal life of the community.

10. That the Authority provide as part of its recreation program an area or areas where buildings which it is desired to preserve may be re-erected when they cannot be retained on the original site.

LAND USE

11. That the Authority consider establishing one or more pasture farms, particularly on the limestone plains, to ascertain the costs of brush removal and the cultural practices best suited to this kind of country.

12. That the Authority promote the ideals and ideas of conservation farming through a program of publicity and public education.

13. That the Authority arrange technical and direct aid, as seems desirable, in the construction of special conservation measures.

14. That the Authority explore fully the possibilities of developing part of the Cameron Swamp for intensive agricultural use.

FORESTRY

15. That the Authority, under agreements with co-operators or through lease or purchase of suitable woodlots, undertake the development of Woodlot Improvement Projects to demonstrate the advantages of better forestry practice.

16. That the Napanee Authority Forest be expanded through a definite program of annual additions and planting until the total recommended area of 82,750 acres is acquired and reforested.

17. That the Authority encourage private reforestation by purchasing a tree-planter and providing a planting service at nominal cost on land suitable for machine planting, and by offering a planting subsidy where hand planting is necessary.

18. That the Authority, by purchase of equipment, organization of cutting crews, or direct subsidy, encourage private owners in thinnings and improvement cuttings in their woodlots.

19. (a) That the Authority investigate the Halton County fencing scheme, and adopt such a modified scheme as seems most likely to result in elimination of woodland grazing.

    (b) That the Authority publish a simple, attractive bulletin on the disadvantages of woodlot grazing.

20. That the Authority co-operate with schools, government departments, and all other groups and agencies possible to publicize the need and the methods of reforestation and woodlot management; and in particular that the Authority sponsor tours, practical demonstrations and field days for this purpose.

21. That the Authority act as co-sponsor for:
    (a) 4-H Forestry Clubs
    (b) The Tree Farm movement.

22. That the Authority assist in investigating and publicizing markets and marketing methods for woodlot products to encourage:
    (a) maximum use of low-grade materials from thinnings and improvement cuttings
    (b) closer and more uniform appraisal of timber, whether standing or in the log
    (c) marking of trees for removal
    (d) securing of competitive bids for timber
    (e) insistence on a written Timber Sales Contract.

23. That the Authority investigate and urge the implementation of the best method of providing fire protection for wooded areas within the watershed in co-operation with the Department of Lands and Forests.

24. That the Authority encourage the establishment of windbreaks, shelterbelts and snowfences.

WATER

25. That the Authority proceed to purchase the dam and reservoir sites of the Third, Fourth and Fifth Depot Lakes when they have received the contour plans of same showing the township lots affected.

26. That the reservoir sites be developed at least to their average annual filling capacity.

27. That when the contour plans of Third, Fourth and Fifth Depot Lake reservoirs are completed, a decision be made as to the next dam to be built and that it be constructed as soon as funds are available in order to supplement the sustained flow required at the town of Napanee.

WILDLIFE

28. It is recommended that the introduction of fish into the watershed be restricted to those parts of the river which have been shown by the survey to be suitable for the species concerned. This recommendation, of course, does not apply to those sections of the river which were not examined during the survey.

29. It is recommended that the Authority urge that the provisions of The Ontario Water Resources Commission Act, 1957, and of the Government of Canada Fisheries Act, R.S. 1952, Chapter 119, Section 33, concerning the prevention of dumping of sawdust and other wastes into rivers, be applied in those cases known on the Napanee River.

30. It is recommended that the Authority devise ways and means to attempt an introduction of the Hungarian Partridge into the farming land of the watershed.

31. It is recommended that the Authority urge that regular tests of the oxygen content and the phenol content of the Napanee River below Strathcona be carried out after the construction of the Second Depot Lake Dam.

HISTORY

CHAPTER 1

THE INDIANS AND THE FRENCH

In 1615 Samuel de Champlain twice crossed the mouth of the Napanee River and the area in which he was lost by himself is reputed to be that between the Napanee and Salmon Rivers in the present township of Sheffield.

The Iroquois fortified village or "Castle" of Ganneious shown on French maps after 1670 was on the Napanee River but its location varies on different maps though it is generally supposed to have been near the site of the present town of Napanee. This castle along with other Iroquois fortifications was destroyed by Denonville in 1687.

For the next hundred years the region was very sparsely inhabited and the few Mississauga Indians remaining sold the land from the Gananoque to the Trent in 1783.

CHAPTER 2

THE LOYALISTS 1784-1790

Surveys along the St. Lawrence River and the north shore of Lake Ontario were undertaken by the British Army in 1783 to determine the suitability of the land for settlement by the Loyalists. A certain Lieutenant Solomon Johns, was in charge and he records that he crossed the Napanee River on a raft near the present Mink's Bridge.

Settlers began to move into the area shortly after this survey was made and it appears that the first mill (saw and grist) on the Napanee River began operations early in 1787.

The first few years in the life of the new settlements on the Bay of Quinte were years of hardship, when the main problem was how to survive, and the convenience afforded by the sawmills and grist mills was a significant factor in meeting this problem. The settlers had little to spend on luxuries. Even such staples as flour, salt, tea and gunpowder sold at prohibitory prices, and, lacking time and ammunition to hunt, the settlers had little to barter. Each new grist mill was hailed as a great boon by the families near enough to use it. At the Napanee Mills "a small toll was exacted to pay for the daily expenses of the Mill—but this was a mere trifle considering the advantages the settlers saved from loss of time in proceeding to Kingston".

In 1788 came unexpected tragedy. That summer drought set in early and continued unbroken for months.

Before the year 1790, the history of the Napanee valley is not distinct from the history of the Bay of Quinte as a whole. Richmond Township was surveyed in 1787 by John Collins; and the Township of Camden East was included in a proclamation dated July 24th, 1788, among the townships making up the District of Mecklenburg. The first mills at Napanee, built in 1786, were on the Fredericksburgh side of the river, where a clearing of one and three-quarter acres was made, and where a few houses were built to accommodate the mill workers; but there is no indication that anyone not connected with the mills had as yet settled in

View in the Village of Nappanee.

Pen-and-ink sketches by Thomas Burrowes about 1830

Grist Mill, Saw Mills, &c. on the Nappanee River, at Nappanee Village.

the vicinity. Only as the years went by and the "front" Townships of Ernestown, Fredericksburgh and Adolphustown gradually became more fully settled, did the settlers push farther and farther into the remoter parts of Richmond and Camden East; and in time it was more often than not the sons of the original settlers of the "front" who set out to seek their fortunes in the new country farther inland.

As settlement proceeded, the back concessions were in many ways dependent on the older communities of the "front". There were the ties of family and of neighbourliness. Through the settlements on the Bay were the lines of supply by which all sorts of provisions and "utensils" had to be obtained. The ministrations of the Church were established first in the older townships, and only gradually extended to reach the newer settlements on and beyond the Napanee River.

The tide of settlement was not uniform in its flow, for the land was not all equally desirable. The Loyalist and American settlers were looking for land which could be brought into profitable production as quickly as possible. They had little use for heavy land if it needed any draining, and avoided swamps and swales no matter how great their potential fertility. As a rule they also rejected thin-soiled rocky land and sandy "pine barrens" or "oak plains", if anything else was available. What they preferred was rolling well-drained loam, and they would put up with stoniness, lightness, and with steepness of slope, rather than with sourness or wetness.

CHAPTER 3
THE GROWTH OF SETTLEMENT, 1790-1880

1. NAPANEE

The earliest accounts of the Napanee River apply to it the name of Appenea, or Apanee. This is said to be a word of the Mississauga language, but the meaning of the name is not known. Some writers have maintained that the word meant flour, and was given because of the mills that were associated with the falls in the river; but Dr. Canniff and others have shown that the name was applied to the river before the building of the mills in 1786, and W. S. Herrington, in his "History of the County of Lennox and Addington", refers to the name Appanea as "the Indian appellation of the falls before the white man took up any land in the vicinity".

Apart from Robert Clark, the millwright, there appears to be no record of the names of those who made up the little community in the mill clearing at the foot of the falls of the Napanee, in 1785 and 1786. In 1787 the Society for the Propagation of the Gospel in Foreign Parts appointed the Rev. John Langhorn to their mission in Ernestown; the missionary resided at Bath, and paid periodic visits to the various centres of settlement in Ernestown and Fredericksburgh, to each of which he gave a distinctive ecclesiastical name: Hay Bay he called St. Cuthbert's; the "Apanee River Meeting" was St. Oswald's; and "that at Mr. McLeod's Schoolhouse in Ernest Town", St. Thomas's. In 1789 he reported one communicant at St. Oswald's, in Fredericksburgh, where, in the course of the previous winter, he had preached five times. The reports of this mission supply an occasional glimpse of the development of the community that grew up about the mills.

Power Canal Napanee

Cement works about 1900, Strathcona

Broken bridge, Petworth 1907

It is apparent from the 1809 report that the increase of population on the north-west side of the river was by that time beginning to outweigh the numbers living on the Fredericksburg bank, and that only Mr. Langhorn's strong sense of his obligation to keep within the bounds of his "Parish" (Ernestown and Fredericksburgh Townships) prevented him from holding his Sunday services in Richmond Township. Langhorn resigned and returned to England in 1813. As late as 1820, his successor, the Rev. John Stoughton, "Missionary at Bath", reported "that he has hitherto officiated once a month at the Napanee Mills, distant fourteen miles, but he proposes hereafter to confine himself to his own District and Fredericksburg". Not until 1831 did the people of Napanee have a clergyman appointed to minister to them, and even then his duties at Napanee were secondary to his services among the Mohawks in Tyendinaga.

In January 1835, the Rev. Stewart Harpur was appointed as a Travelling Missionary in the Bay of Quinte area; and in June of that year, Mr. Harpur recorded in his Journal:

> "preached for Mr. Givins in the morning at the Indian Church, and in the evening at the Napannee village, where a numerous and most interesting congregation has been formed by the exertions of Mr. G., and a new neat stone church, now near its completion, has been erected by J. S. Cartwright, of Kingston."

A further five years passed before the new church was consecrated. The Rt. Rev. John Strachan, first Bishop of Toronto, made a tour of visitation through the eastern part of his diocese in 1840, in the course of which, on July 18th, he visited the Mohawks, and Napanee village:

> "we drove to the Napanee village, nine miles; but it was so intensely hot, that we were a little beyond our time. The church is a neat stone building, erected principally at the expense of the Rev. Robert D. Cartwright, and his brother, John S. Cartwright, Esquire, both of Kingston, and large proprietors in this neighbourhood. The service was rather long, as the church had to be consecrated. The congregation is at present under the care of Mr. Givins, the Indian Missionary, who has service every Sunday. . . . After drinking tea with Allan McPherson, Esquire, one of the principal inhabitants of the village, we began, though late, our journey to Bath, twelve miles, and arrived at the rectory very late, where we were cordially welcomed by the Rev. A. F. Atkinson, the worthy clergyman of the parish."

In the meantime, the community on the Fredericksburgh side of the river was developing in a way that seriously rivalled the growth of the village in Richmond Township. From the original clearing beside the mills, the houses of the employees spread upstream to the top of the falls; then as they needed room for further expansion, they leaped across an unsuitable strip of shallow soil to the more attractive locality above the bend in the river, where a busy village grew up, and where, in 1834, the Deputy Surveyor, F. P. Rubidge, laid out the town plot of Clarkville, taking its name from Sergeant-Major James Clark, Government manager of the mill.

As Napanee and Clarkville continued to grow, a keen spirit of rivalry grew up between them. Each had its own tavern, each built its own school; in each a

Log boom, Colebrook, about 1905

Last Drive on the Napanee, Colebrook, about 1905

Yarker about 1905

Stone farmhouse near Camden East

Thompson house, Camden East

Clapboard house near Strathcona

store was built. The south side of the river had the prestige of possessing the first mill, and for a time claimed among its residents the only doctor. The Township of Fredericksburgh had been among the first settlements on the Bay of Quinte, while Richmond had remained for several years in the backwoods and the wilderness. It hurt the pride of the good people of Clarkville to think of sending their children to Napanee to school; it gratified them to see the neighbours from Richmond flock across the river to Fredericksburgh to church. But the request of the people of Napanee, in 1809, for a church service of their own reflected changes in the relations of the two communities that could be neither ignored nor resisted. Napanee was increasing in importance; Clarkville was dwindling—and the trend could not be reversed.

In 1846, the population of Napanee was given as "about 500", including two physicians, two lawyers, two saddlers, three blacksmiths, two wagon makers, six tailors, two druggists, one painter, one cabinet maker, one hatter, one tinsmith, two bakers, one watchmaker, one cooper, and one chairmaker. From this time on, the distinction between Napanee and Clarkville disappears, the former name being applied to the whole community.

The town continued to grow. In time the swamp was filled, and the creek was carried through underground conduits. Residences, churches, and schools followed the westward trend of expansion, while the business section of the town, at first confined to the East Ward, pushed gradually westward along Main and Dundas Streets. In 1913, Herrington appeared to think it had reached its final limit at Centre Street.

In 1957, the business section on Dundas Street ended at Robert Street, one block farther west than Centre Street. All this growth to the westward increased the difficulty of operating a successful business in the older East Ward, and completed the doom of the still more ancient Clarkville across the river.

2. STRATHCONA

The first significant rapids in the Napanee River above the town of Napanee occur in the interval between five and six miles from that place; here the river falls some twenty-five feet in the mile, and here

> "In the early twenties of the nineteenth century Adam Bowers built a mill at the foot of the rapids, and the place was for many years known as Bowers' Mills. Adam was a Lutheran and brought his children up in the same faith; and his son John built a stone church upon his farm at the Mills."

About 1850, an American firm bought out the Bowers' privilege, and undertook lumbering operations on a large scale; and the hamlet came to be known as the Yankee Mills. In 1861, a post office was established, and the name selected for it was Napanee Mills, one that gave rise to great confusion, because it was common practice to refer to the early mills at Napanee as the Napanee Mills, and because the mills built in Napanee by "the estate of the late John S. Cartwright, M.P.P." in 1846 had been named the Napanee Flouring Mills.

In the early seventies, the mills at Napanee Mills were sold to H. M. Wright and Company, who organized the Napanee Paper Company, tore down the sawmill, and built a paper mill on its site. While the paper mill continued in

Colebrook 1910

Camden East

Mill at Yarker

Wooden Pump Worker, Colebrook

operation, the Wrights became interested in a new venture. It was discovered that the limestone formation on which their mills stood provided suitable material for the production of Portland cement.

This era of prosperity lasted for some years, but could not survive the changes that those years brought. The supplies of raw material for the paper industry became exhausted, and the paper mills were closed. The cement company was taken over by another concern, who removed it to Marlbank, one of the sources of its raw material. The extensive cement plant was dismantled, about 1904, leaving only a broad scar across the face of the hill that overlooks the Napanee River, and an undated photograph clipped from an unidentified publication.

At the close of the South African War, the name of the village was changed to Strathcona, in honour of one of the leaders in that war; and Lord Strathcona, then Canada's High Commissioner to London, gave $1,000 to a public library in the village.

At a later date, a new paper mill venture was established at Strathcona, which has for many years been the principal industry in that vicinity.

3. NEWBURGH

The village of Newburgh founded in 1822 is the second largest centre of population in the Napanee Watershed. David Perry built the first sawmill in 1824 and a grist mill in 1826. A second sawmill was constructed in 1825, a tannery in 1832, the Union Flouring and Grist Mills in 1840, "containing three run of stones and one barley stone", an oatmeal mill in 1861 and a woollen mill in 1865. In 1871 John Thomson built the paper mills.

Newburgh was fast becoming a very active industrial community. Besides the mills noted above, there were in 1865 two carding mills; two axe factories; one foundry; an agricultural implement factory, manufacturing reapers, mowers and threshing machines; a sash, blind, and door factory; three carriage and wagon shops; a hub and rake factory, and two cabinet factories.

An institution of which Newburgh has long been proud is the Newburgh Academy. The date of its first establishment is not known exactly, but the best estimate of one investigator, George Anson Aylesworth, gives 1839 as the most probable date.

Both Wesleyan and Episcopal Methodists established churches here as did the Anglicans and Presbyterians.

4. CAMDEN EAST

Two miles upstream from Newburgh is the village of Camden East, which had its beginnings in the building of a dam and sawmill in 1818 by Abel Scott. The original mill was located some distance above the present site of the village, where the dam caused much damage by flooding the adjacent lands. Scott sold his privilege in 1821 to Samuel Clark, who, when he first came from Ernestown, built three mills, a sawmill, a grist mill, and a carding and fulling mill.

The Hinch House, 1828 near Camden East

Moscow 1948

Newburgh 1948

W. S. Herrington traces the early history of Camden East back to a much earlier period than that of the building of the first mill by Abel Scott. "Isaac Coté, a trapper, is said to have been the first white man to occupy any portion of the land upon which the village now stands. In the latter part of the eighteenth century he built a log cabin, the ruins of which Mr. Lockwood remembers having pointed out to him over seventy years ago." (Earlier than 1843.)

Many years before the date of Abel Scott's mill, Albert Williams moved from the Township of Fredericksburgh and settled on Lot No. 25 in both the first and second Concessions of Camden East. At some time between 1800 and 1804, he built on the south bank of the river his first house. A few years later, after there was a bridge over the Napanee River at Camden East, he built a new house on the north bank. In 1881, Lorenzo Dow Williams, grandson of Albert Williams, built upon the same property "the most imposing farm residence in the county", a three-storey brick house in the construction of which a large quantity of white marble was used.

5. YARKER

As part of the lands to which he was entitled as a military officer, Governor John Graves Simcoe was granted, in 1796, a tract of land in what was then an unexplored wilderness in the south-eastern part of the Township of Camden East, comprising one thousand acres, known for many years as the Simcoe Tract. Upon the death of Governor Simcoe, the tract passed to his third and only surviving son, the Rev. Henry Addington Simcoe. "To the north of the Simcoe Tract was a hamlet called Peters' Mills, now the Village of Colebrook, and four miles to the south was the Village of Wilton."

One of the leading citizens of the Village of Wilton was Sidney Warner, maker of potash and proprietor of a large general store. In 1840, Mr. Warner bought the Simcoe Tract, and sold to David Vader, who built a sawmill at the falls. The village that grew up about this mill came to be known as Simcoe Falls until 1859 when it was changed to Yarker.

At various times since there have been sawmills, planing mills, wagon and wheel factories, flour and grist mills, woollen mills and a foundry and machine shop at Yarker.

6. COLEBROOK

About a mile north-east of Yarker is the Village of Colebrook. Eli Peters built a sawmill on the Napanee River at this point and on a map of the Midland District, made in 1836, the site is marked Peters' Mills, a name which persisted for many years. The mill was at first equipped with one saw only, an upright one; and when business increased a second saw was added.

Through the influence of the Warner brothers, Peters' Mills obtained a post office before Vader's Mill, and the name of the growing village became Colebrook. The change brought increased business to the Warner enterprises, and prosperity to the Warner family. The state of business was reflected in the new stone residence, built in 1855, which, more than a hundred years later, is still one of the landmarks of the village.

Newburgh Academy

School, Enterprise

Abandoned schoolhouse at Sangster Bedford Township

Ruins of Mill at Petworth

Ruins of Thompsons Paper Mills, Camden East

According to Herrington, a flood on the Napanee about the year 1863 carried away the bridge at Colebrook, and a ferry was in use until the bridge was replaced.

The Directory of 1865 refers to Colebrook as a flourishing village with a population of about 250; and among the business enterprises names the following:

Shibley, Charles, sawmill proprietor.
Warner, D. S., flour and sawmill proprietor.

Colebrook has one church, now the United Church of Canada, built in 1874 as the Methodist Episcopal Church. The present square tower of this church was originally topped with a tall slender spire.

In 1877, the village suffered a disastrous fire that swept the west side of the river, destroying a sawmill, three stores, two hotels, and five dwellings.

7. MOSCOW

Two sons of Elias Huffman, Elijah and Jacob, became the first settlers of Moscow, three and a half miles north of Colebrook.

Elijah Huffman was a hunter with a genius for exploration. In the autumn of 1823, when he was thirty years old, one of his hunting excursions took him far into the almost unknown country between the Napanee and the Salmon Rivers. Arriving at a post recently planted by a surveyor to mark the line between the Fourth and Fifth Concessions of Camden Township, Elijah was impressed with the majestic forests and the richness of the soil, and formed the intention of making his home there. Returning home to Fredericksburgh he interested his family, and early the following summer, he and his brother Jacob returned to the spot that had so attracted him.

As there was no church in the growing community religious services were held in the homes of the people, and sometimes in new barns, "before they were used for the storing of crops". The early settlers were mainly Methodists, both Wesleyan and Episcopal branches being represented. "There were also a considerable number who belonged to the Church of England, and quite a number of 'Orthodox Quakers', later known as 'The Society of Friends'."

The early agriculture gradually developed into a dairy business, and the production of butter and cheese. The first cheese factory within reach of the farmers of Moscow was built at Colebrook. Later, George Garrison built a cheese factory at Moscow, which has continued through several changes of ownership to the present day.

For the first thirty years of its existence, the Huffman Settlement continued without a post office. On April 1, 1854, a post office was established with John Crommer as postmaster, to which the name Springfield was given. One month later, the name was changed to Moscow.

8. PETWORTH

Closely linked with the life of Moscow was that of the little village of Petworth, located on the Napanee River about two and a half miles south-east of Moscow. Joseph Foster, in 1840, built the first sawmill at Petworth.

Roman Catholic Church
Centreville

Methodist Church, Lens

Anglican Church
Newburgh

The lumber business, which was the main-stay of the life of Petworth, got under way in 1850, and for fifty years was prosecuted with great vigour; and the village prospered accordingly. But the day came when "the timber barons had completed their job, our forest reserves of white pine were completely exhausted, the last drive of timber had passed down the River, and the people wondered what would happen next". The "history of the village of Petworth with only six families left, furnishes a striking example of what can happen to a community when its major industry collapses".

9. ENTERPRISE

In Anderson's Directory of Ontario, 1869, Enterprise is described as "a Village in the Township of Camden, County Addington, situated on Jackson's Creek, 20 miles from Napanee the County Town. Average value of improved land in the vicinity $30 per acre. Stages to Newburgh and Napanee. Population 150". About 1855, Robert Thompson opened a general store on the north-west corner of the intersection of the line between Lots 37 and 38 with the road between Concessions 7 and 8, Township of Camden; the little hamlet was then known as Thompson's Corners. A map published in 1860 shows the village under the name of Enterprise, and gives the names of the proprietors of three stores, besides a woodworking shop, a temperance hall, a sawmill and a hotel.

The first church building in Enterprise was that of the Wesleyan Methodists, which was subsequently acquired and used by the Church of England.

10. CENTREVILLE

The first settlement in this vicinity was made in 1815, by John Milligan, John Rombough, John Whelan, and Jehial Hawley. The village plot was laid out in 1847, by William Rombough, for the proprietors, James F. Hawley and John Whelan; and for many years the community went by the name of Whelan's Corners. The post office was established in 1849, when the name was changed to Centreville, a reminder of its central position in the township.

In 1865, the village contained four stores, several "workshops", two schools, and three churches—the two Methodist churches and one Roman Catholic. The original Catholic church was a frame structure, but by 1865 this had been replaced by the large stone church that still stands about a mile south of the village.

Centreville reached the peak of its prosperity about the year 1870, and thereafter began to decline. Fires destroyed three hotels in the village, people moved away, the churches dwindled, and the parsonages were vacated. One notable fact had always been the lack of water power. Centreville became the shopping centre for the agricultural community round about, and the home of a cheese factory which, since 1870, has served that community.


LAND

CHAPTER 1

GEOGRAPHIC ASPECTS

1. INTRODUCTION

The watershed of the Napanee River extends north-easterly from the Bay of Quinte a distance of some 36 miles. The drainage area is somewhat like a funnel in shape, with the small end opening into the bay. At its broadest the valley is about 21 miles wide and at Napanee near the outlet about 2 miles. The area drained by the river is some 202,000 acres, or approximately 315.6 square miles.

Politically the watershed is more or less bisected into an eastern and western portion by the Frontenac and Lennox and Addington county line. It contains portions of 10 townships: Kennebec, Hinchinbrooke, Portland, Bedford, Loughborough, Sheffield, Camden East, Ernestown, Richmond and North Fredericksburgh. There is one town (Napanee), one village (Newburgh), and various smaller communities, including Yarker, Camden East, Verona, Enterprise, Moscow, Strathcona, Bellrock and Centreville. All of these centres are located in the southern half of the watershed where almost all of the agricultural land is found.

2. HYDROGRAPHY

The Napanee River begins upstream in the Cameron Swamp (Verona Bog) which is fed by a number of headwater tributary streams including Carman Creek, Whiteman Creek, Depot Creek and Hardwood Creek. Each of these streams drains and runs through a chain of lakes, some of which are up to 80 feet or more deep. In some cases the latter are a fair size. The Depot Creek drains, for instance, the First, Second, Third, Fourth and Fifth Depot Lakes, as well as a number of smaller ones.

The two largest lakes on the watershed are to be found on the limestone plain between Yarker and Enterprise. Camden (Mud) Lake is the larger of the two and embraces about 900 acres. Varty Lake is approximately 750 acres in size. Both lakes are shallow and rather weedy.

The Napanee River drops about 200 feet between Cameron Swamp and Napanee and its passage is marked by numerous falls and rapids. The falls at Yarker, Newburgh and Napanee are significant and spectacular and early in the period of settlement gave rise to grist and other mills. Below Napanee the river has more the appearance of an estuary and is navigable by commercial vessels of small size.

Numerous small tributaries enter the river below Cameron Swamp but most, if not all, flow only intermittently. In the spring of the year they are quite active and many cascade down the valley slopes into the river.

The sediment load of the river is low, partly because of the numerous natural settling basins and partly because so much of the watershed is permanently covered by grass and forest growth. The river water itself has a rusty hue, due, it would seem, to the mineralogy of the bedrocks and to the Cameron Swamp.

The stream pattern in the watershed has been influenced greatly by the surface disposition and structure of the bedrocks. The deranged pattern found in the northern portion is typical of the Shield and is due to the comparatively recent glaciation. In the limestone area the river flows through an old pre-glacial spillway, the trend of which is apparently conditioned by lines of weakness in the bedrock. A number of other streams in the area, for example Salmon River, Millhaven Creek, Blessington Creek, follow the same trend.

3. BEDROCKS

Basically the watershed contains bedrocks of two major types. To the north of the Cameron Swamp are found the granites, gneisses, schists and crystalline limestones of the Precambrian Shield, and to the south of it the more recent sedimentary limestones and shales of Ordovician age.

The rocks of the Shield represent the remnants of an old land mass which has been warped and eroded for many millenia. More recently these rocks have been subject to scouring and grinding by the great continental ice sheets. In this northern portion of the watershed the ice action on these hard rocks created a landscape where barren rock knobs intermingle with hollows filled by fluvial or morainic sands and gravels, by water, or by peat and muck where former ponds have filled with vegetation. The aspect generally is a bleak one from the point of view of agriculture but it holds great charm for the vacationer, principally because of the many lakes. Even where cultivable land exists in sufficient acreage to support a farm or two the soils often tend to be acidic and deficient in fertility.

The agriculturally fertile section of the valley lies to the south of the Shield but even here development is spotty because of ice scouring of the level-bedded Ordovician rocks. Where the bedrocks are more thickly covered by soil materials, satisfactory crop production may be achieved. A large proportion of the thin soil area is devoted to permanent unimproved pasture.

These sedimentary rocks, consisting of limestone, shale and some sandstone and conglomerate, were laid down over the Precambrian rocks during Paleozoic time. Geologists have separated these rocks into formations according to age and characteristics. The southern section of the valley is underlain by the Trenton limestones and beneath these are the Black River group. Superficially both are much alike.

Once reaching further north, these sedimentary strata have been eroded away to expose the Precambrian beds they formerly covered. The junction between the Shield and the limestones is frequently marked by a cliff of varying height to which the name Black River Cuesta has been applied. Extensive swamps and poorly drained areas, such as those flanking Cameron Creek, are common along the line of contact between the Shield and the sedimentary rocks. Beyond the main sedimentary mass may be found residual hills of limestone such as Basswood Hill. These mesa-like structures will eventually disappear as the erosion cycle progresses.

Although unproductive for agriculture the bedrocks of the watershed have had a varying economic importance. The sedimentary rocks were useful in the

The sedimentary rocks are usually level-bedded and often outcrop in prominent minor cliffs. The shale layers are less resistant to weathering than the limestone.

In a few places the limestone strata have a dip substantially away from the horizontal.

past in the manufacture of cement and from early settlement days the limestones have been utilized for building purposes. Building stone is not taken frequently now but the many stone houses, mills and other buildings lend a charm to the landscape which is missing where more conventional materials are used.

The bedrocks of the Shield have been economically productive in many ways. Throughout the area one may find abandoned mines where zinc, mica and other minerals have been quarried. Certain rocks are still being quarried in the Verona area for the manufacture of poultry, roofing and other grits.

4. CLIMATE

Climatological data are unavailable specifically for the Napanee Watershed. The nearest weather recording stations are located at Belleville, Kingston and Tweed. An examination of these statistics sheds some light on the general climatic picture of the valley. It would seem that local topographic and other conditions influence the local climatic regime to some extent.

The lake effect is felt more keenly by Kingston than by Belleville which, though on the Bay of Quinte, is comparatively inland. This is significant particularly as it affects the annual precipitation and frost conditions. In these matters Napanee could be expected to be more like Belleville than Kingston. The Shield portion of the watershed should, logically, resemble Tweed, although these facts have no particular bearing insofar as the sparse agriculture of this area is concerned.

One of the chief climatic hazards on the watershed is that of drought. According to Sanderson the computed amount of water needed for the growth of vegetation in the agricultural portion of the Napanee Valley is of the order of 23-24 inches. Computed water surplus in the area is about 11.5 inches, water surplus being precipitation in excess of need after the soil moisture has been replenished. It drains away and becomes unavailable to vegetation. Sanderson notes that "A large average water surplus is not beneficial to the soil since it annually removes needed nutrients beyond the range of plant roots. Large surpluses also make farming operations difficult and costly, by keeping the ground muddy and intractable in spring, delaying sowing operations and necessitating drainage. However, a surplus is agriculturally important in recharging ground water supplies and providing water for livestock and irrigation."

The areas in the watershed where water surpluses would be most harmful from the point of view of cultivation would be those agriculturally most productive. These include the Moscow plain, the clay lands along the lower reaches of the river, and the stiffer tills and residual soils on the flat limestone plains. Over a large area soil drainage is free and excess water soon percolates away.

When the water need exceeds the supply of moisture in the soil, moisture deficiency or drought occurs. Average annual water deficiency in the Napanee Valley ranges from about 2 inches in the north to about 4 inches in the south. This calculation is based on the assumption that the amount of water in the normal soil available for vegetation is 4 inches.

In some places bouldery limestone moraine is best used for rough pasture or forest.

Finer outwash deposits near Centreville and in the granite country often provide fair agricultural land and road material.

In the lower Napanee Valley slumped kame terraces are used for pasture and building materials.

An assumption that there is a normal soil implies that some are abnormal and can hold either more or less than 4 inches of water. In the Napanee Valley those which can hold less are the critical ones and they include the thin-soil limestone plains where surface run-off may be low but percolation is rapid. Probably chiefly because of this factor these plains suffer severely from drought in a normal summer and the carrying capacity of the pastures is much reduced under their spring-time potential. Many of the sands and coarser tills also probably suffer a greater deficiency than is suggested by the figures for the watershed as a whole. A deficiency of moisture is always harmful to a crop, in reducing the yield and making the plant susceptible to disease. Moisture deficiency, except in those areas where irrigation may be practised, can be expected to reduce crop yields below potential in most, if not all, years.

5. PHYSIOGRAPHY

In common with a large portion of North America the Napanee Valley has undergone, during the past million years, a series of continental glaciations. According to available evidence there have been at least three glaciations, each being marked by fluctuations. These advances and recessions varied in magnitude in different regions. The ice of the last glaciation, the so-called Wisconsin, left the Napanee Valley under the impress of a warming climate perhaps not much longer than 10,000 years ago. Between each of these ice ages there were long periods during which the climate was warmer and the land was ice free.

During their passage these ice sheets acted as eroding agents, plucking, quarrying and grinding the bedrock and surface deposits and mounding and spreading the pulverized material. This unstratified, stony material is known as till and the rock materials composing it were often carried considerable distances from their point of origin. Succeeding ice sheets largely destroyed the work of the one before so that the topography seen in Southern Ontario today is chiefly the work of the Wisconsin ice and of post-glacial drainage. The landforms resulting from the ice action were of several kinds and some of these may be found in the Napanee Valley.

In its movement the ice often spread the till beneath it to form an undulating plain of low relief. Such a sheet is known as a till plain; its slopes are generally smooth but soil drainage may often be a problem. The Moscow, Centreville and Harrowsmith areas may be regarded as till plains although the till in these areas is relatively thin over the underlying bedrock.

Sometimes the till was moulded under the ice into the form of oval hills known as drumlins. Locally these are often known as "whaleback" hills. Over Ontario the dimensions of these hills may vary but they are often up to 75 feet in height, ¼ mile in width, and ½ a mile or more in length. Usually they are clustered in great fields to form the pleasing and so-called "basket-of-eggs" topography. Drumlin soils are usually loamy, fairly fertile and well drained but steep slopes and the stony nature of the soils may provide some difficulties to cultivation. Good management is necessary to prevent severe sheet erosion of the smooth slopes. In the watershed a number of specimens may be found, chiefly in the lower portion of the Napanee Valley. They are part of a more extensive field found outside the watershed to the west.

During its movement the ice often piled great ridges of till along its border. These ridges, known as till moraines, may be very rough and bouldery and are often unproductive for agriculture because of these factors. Extensive deposits of this kind are lacking in the valley but numerous small moraines may be found here and there throughout the watershed, particularly in the northern portion.

Two major landforms in the valley resulted from the scraping action of the ice on the bedrock. In the north, on the Shield, the ice removed the previous soil cover to form the present rock knob upland. In the south the same thing occurred but the more or less level bedding of the sedimentary strata restricted differential erosion by the ice with the result that a level thin-soil or soil-free plain was formed. In both cases the land was left largely unproductive for most forms of agriculture.

As the climate warmed the ice retreated and poured off vast quantities of melt-waters. These waters, of themselves and from the lakes they formed, were important in the creation of landforms of significance.

The pre-glacial valley of the Napanee River was further eroded by the ice of the glacial period and by the melt-waters pouring off the ice as it retreated. These melt-waters often moved at high speed and were able to carry large amounts of sediment in the form of sand, gravel, clay and silt. The coarser components were often dumped along the edge of the ice into rough hills of stratified sand and gravel. The landform resulting is called kame moraine and many small examples may be found on the watershed particularly in the northern section. Such land is usually rough, droughty and lacking in fertility and is consequently not valued for agriculture. The kame terraces along the slopes of the lower valley are similar. They are valued chiefly as a source of road metal and building materials.

During the period of ice retreat numerous small temporary lakes were formed, particularly in the Shield where the topography lent itself to minor impoundments. These were often filled with sandy materials, and, when drained, left a small sand plain. Where the soil drainage is adequate these areas are useful to agriculture. On some farms such land forms the bulk of the agricultural land although nutrient deficiencies are common.

As the ice retreated from Ontario a succession of great glacial lakes were formed. One of these, Lake Iroquois, occupied the Lake Ontario basin but its waters were much deeper and covered a far larger area than do those of the present lake. In the Belleville and Napanee areas these waters extended far inland from the present shore. Coleman suggests that all of the watershed south of a line drawn between Petworth and Centreville was submerged by Lake Iroquois. Some of the clays near Napanee were constructed by the waters of this lake.

6. THE PHYSIOGRAPHIC REGIONS

The multiplicity of landforms on the Napanee Watershed occur in particular combinations which are separable into distinct physiographic regions. These regions are a vital reality in the agricultural and other activities of the residents of the watershed. Although the people may call them by different names, the

Bedrock at the surface on the limestone plain. Note the solution cracks along the joint planes.

On the limestone plain the soil is often thin and the pasture sparse.

general location and particular individuality of the regions will be appreciated. Not all of these regions are confined, of course, entirely to the watershed; some extend beyond it.

(a) ROCK KNOB UPLANDS

This area lies entirely within the Shield of which it forms a small part. Although termed an upland the elevation is, in reality, not great; nor is the relief, although the country is rugged and bare rocky knobs, lakes and swampy areas are common. The elevation rarely exceeds 700 feet above sea level.

The soils are light, often stony and, except near Bellrock, Verona, Godfrey and Wilkinson where deeper pockets are found, are usually too thin and limited in extent to be useful to agriculture. The future of the area rests chiefly in the exploitation of its present and future forest, its recreational, water and possibly mineral resources. In this region are located the largest tracts of forest land so far acquired by the Napanee Conservation Authority.

(b) CAMERON CREEK SWAMP

This extensive swamp lies in the middle of the watershed between the Shield on the north and the limestones on the south. Undeveloped at the present time, it is the largest in the valley and is dealt with more completely elsewhere in this report.

(c) THE UNDULATING CENTREVILLE PLAIN

This area, lying mainly over limestone bedrock but protruding into the Shield north of Enterprise is a rolling plain of light and medium-textured tills. Kame materials may be found, and also a few drumlins. Low-lying areas present drainage problems.

In this region of moderately good soils a reasonably prosperous mixed-dairy agriculture has developed. The region extends to the west beyond the watershed boundary. Enterprise is the local centre.

(d) THE MOSCOW TILL PLAIN

The somewhat waterworked till deposits of this area are level and moderately deep. The soils are moderately fertile and although drainage is sometimes a problem in places a good local agriculture based on milk production has been achieved. The cheese factory at Moscow, the small centre for the area, is one of the few remaining in the watershed.

(e) THE LIMESTONE PLAINS

These plains occupy the bulk of the southern portion of the watershed away from the river valley itself. The topography is generally subdued and quite level. Over wide areas the dull-grey, fissured limestone is exposed at the surface or is within a few inches of it. Elsewhere, deeper deposits of drift may be found and a lively agriculture supported. Pasture and trees are the chief crops on the thin-soil land and both are affected in summer by drought due largely to the open nature of the soil and bedrock. The two largest lakes on the watershed, Camden and Varty, occupy extensive shallow depressions in the plain.

(f) LOWER NAPANEE VALLEY

This portion of the watershed may be considered to occupy a band of

varying and indeterminate width along the Napanee River, and to extend from Colebrook to Napanee. On either side of the river the valley rises quite steeply and rock ledges are common. The soil deposits in the valley are variable in depth and kind and include light and medium tills, outwash materials and lake deposits or deposits reworked by lake water. By and large the river flats are quite narrow but here and there they widen sufficiently to be available for field crops. Dairying is the most important farm occupation but some beef cattle are kept. In the vicinity of Napanee, and at some places upstream, market crops, particularly raspberries, are important.

Through this valley are found the town of Napanee and the villages and hamlets of Strathcona, Newburgh, Camden East, Yarker and Colebrook. A main road and a railway parallel the river and it is from each of these, rather than its physiography, that the region obtains its character.

(g) NAPANEE CLAY PLAIN

This relatively level clay plain enters the watershed on the south-west. The soils are well to imperfectly drained and are used considerably for the production of cash crops.

Each of the regions outlined above has problems in conservation which are found elsewhere in the watershed. At the same time each of these regions has one or more problems which, while not unique, are more peculiar to itself simply because there are differences in soils, availability and quality of agricultural land and so on. In dealing with and managing its watershed the Authority should keep these differences in mind.

7. SOILS AND SOIL EROSION

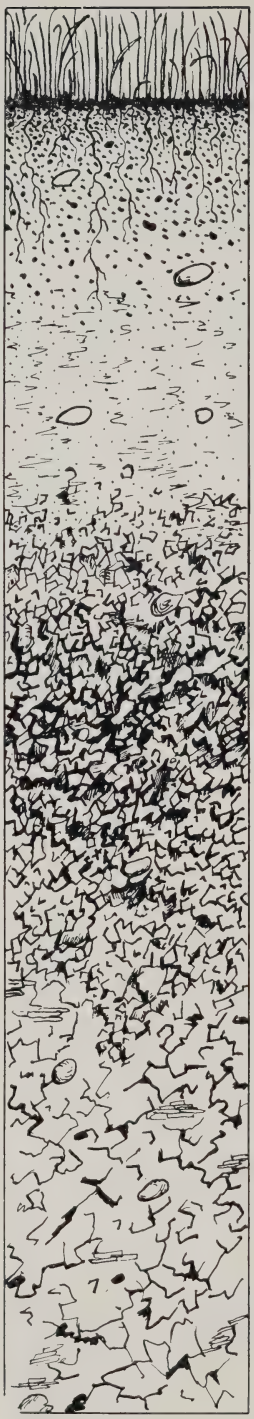
(a) INTRODUCTION

In watersheds where county soils maps are available it has been the practice to use these maps and reports as the basis for watershed mapping and planning. Although many of the counties of Southern Ontario have been reported on, reports have not yet been published for a number of others, Frontenac and Lennox-Addington among them. This being so, the present survey of the Napanee Watershed was carried out in a slightly different way to that usual where maps of the Ontario Soil Survey are available.

Where these maps and reports exist soil conservation survey work is based on the soil type. Where they do not exist, as on the Napanee, the somewhat broader category of parent material type is used. Basically, however, the difference is one of degree rather than kind and the eventual classification of the land according to its capability is the same. In the mapping, those features of the soil such as severity of erosion, slope and drainage are the same regardless of which system is used.

(b) THE SOIL PROFILE

Although soil may be described loosely as being the medium in which most plants grow, even general observation reveals the fact that there is considerable variation in the soil and in its ability to support crops. Not only is there variety in the materials making up the soil but different soils of different capability may develop on much the same type of material.



PRESENT VEGETATION

A1
6" HUMUS BEARING HORIZON
Dark brown, friable loam
sometimes stony

A2
6"–15" HORIZON OF
LEACHING, Pale brown or
greyish, powdery loam
sometimes stony

B
15"—30" HORIZON OF
ACCUMULATION, Compact
nut structured, reddish–
brown and brown clay loam
may be stony

C
PARENT MATERIAL, Light
greyish brown shale and
limestone till, some stones
and boulders

Profile of a representative grey-brown podzolic soil.

As described here the soil is a reflection of the environment in which it developed. As a result, the development of any particular soil is a matter which involves a number of factors, some one or group of which may be of more importance than the others. Type and composition of the parent material, surface slope, soil drainage, climate and vegetation are some of these factors. In any single instance they operate together in such a way that, given time, they produce a soil possessing certain recognizable characteristics.

If a vertical cut is made to a depth of three or four feet through the soil it will be seen that the cross-section is marked by a layering, each layer, or *horizon,* possessing certain characteristics of colour, texture, structure, organic content, acid reaction and so on. Together these horizons make up the soil *profile.* The depth of the profile is variable, in some soils a foot or less and in others several or many feet. In point of time most of the profiles on the Napanee Watershed are shallow and the soils youthful. Over much of the watershed the bedrock is at or very near the surface and there is little or no soil, much less a profile, to speak of.

(c) SOIL EROSION

Many people are possessed of the misconception that erosion of the land, that is, the translocation of soil materials from place to place by the natural forms of wind or water, can be stopped completely. This is impossible, except, perhaps, over small areas, for relatively short periods of time, and under certain conditions. Through the ages erosion of the land has taken place, moulding it into the scenery we see today. Under natural conditions this erosion is a very slow process and long years are required to alter the landscape appreciably. We call this form of erosion "geologic" erosion.

Under natural conditions the face of the earth is masked by a cover of vegetation and it is this cover which is chiefly instrumental in retarding run-off and slowing down erosion by wind and water. Because of the slow rate of erosion the soil, as seen in the profile, is not greatly affected by it and the process of soil building is easily able to keep pace with it. While conditions remain more or less the same the loss of a fragment of surface soil is offset by an increment from below as the parent material weathers and is incorporated into the soil. Under conditions such as this, nature is, by and large, in balance.

When the land is cleared for cultivation or used for grazing, however, this picture may be greatly changed: the protecting cover of vegetation is removed or reduced; cultivation may be carried on up and down the slope and surface water enabled to flow over the land more easily; the structure of the soil changed for the worse and organic content lessened with the result that the soil's moisture absorptive capacity is impaired. All of these changes can easily produce, in a rather short time, a less productive or even a ruined soil.

Such erosion is called induced or "accelerated" erosion. It is this erosion that the conservationist is concerned about and which every farmer should be aware of.

Some soils erode more readily than others and the same soils under different forms of land use may show vastly different amounts of erosion. There are also

other factors which affect the rate of erosion: surface slope, topography, intensity of land use, rate of rainfall and the physical condition of the soil. For these and other reasons a farm plan based on conditions peculiar to the individual farm is desirable to control erosion.

In Ontario the removal of soil by erosion is accomplished by wind and water; the former is of importance in only a few areas, chiefly those of light soils. Erosion by water is much more widespread although, as intimated, it is more damaging on some soils than on others.

When the surface run-off is concentrated into channels which are unprotected, or inadequately protected, gullies may develop. This is the most spectacular form of erosion in Ontario and a gully can grow quickly to the detriment of the land and the farmer. Fortunately, this form of erosion is not common on the present watershed but some gullies are found cutting back through streambanks. Run-off channelled in an unprotected field, unprotected tile drain outlets, and channels formed through cattle always using the same path are among the contributing factors leading to gully erosion.

At the start a gully may be insignificant but it can become large very rapidly. Small rills which are found on the slope of a cultivated field after a heavy rain and which can be covered over at the first cultivation are danger signals every farmer should heed.

Sheet erosion is much less spectacular but is dangerous because it is so widespread and most often goes unnoticed. This form of erosion usually takes place relatively slowly, but a whole field may be affected, with the result that the humus-rich portion of the soil, together with its store of available nutrients, is removed. Much of this erosion takes place during summer storms, just at a time when crops need the moisture which is flowing over the surface of the land into the streams. A reduction in the run-off would thus prove directly useful in at least two ways: reduced erosion and increased moisture supply for crops.

Many measures may be adopted to control run-off and reduce erosion. Land kept under a permanent cover of grass or trees and properly managed may erode very little. The same may be true on level lands regardless of the form of use, although, of course, the land may become less productive unless soil management practices are adequate. Soil-building rotations, the use of cover crops and fertilizers, contour tillage and grassed waterways are among the measures that may be used.

(d) THE ESTIMATION OF EROSION

There are a number of ways of determining whether erosion has taken place and the amount. The effect of erosion may often be easily seen in poor crop response due to drought. On slopes or knolls where the A and/or B horizons have been removed, the soil is less able to absorb moisture, and the crop may be thin and weak. Where erosion has been severe, the grayish parent material may be seen at the surface. A patch with an excessively stony surface may also be a sign of severe erosion and reflect the removal of the finer soil constituents. Erosion of this severity is relatively rare on the watershed.

Where observations such as this may be made, other evidence is also usually available: sediment may be seen to have accumulated at the bottom of a slope; soil may accumulate on the uphill side of a fencerow, while the downhill side is cut away.

To get a more certain determination of the degree of erosion the soil profile must be examined. It is usually possible to find a good profile of a virgin or nearly undisturbed soil in woodlots and along old fencerows.

(e) SOIL EROSION ON THE WATERSHED

Generally speaking the agricultural lands of the watershed have suffered from erosion in only a minor way. Part of the reason lies in the fact that a large portion of the cultivable land is level to gently sloping. Erosion is more severe where the slopes are greater, as, for instance, on some of the valley lands adjacent to the Napanee River.

The bulk of the cleared land is devoted to pasture and hay and these are normally excellent erosion control crops. Over wide areas pasture is the only possible crop, apart from trees, and the question is simply one of restricting over-grazing. It is a difficult point to prove but it is believed that some of the thin soils on the limestone plain have suffered severely from past mismanagement. In the northern part of the watershed erosion resulting from agricultural mismanagement is slight but fire, and perhaps grazing, have no doubt damaged the soil cover and hindered forest regrowth.

In addition to removal of the soil by wind and water there is also the question of lost soil fertility. Where this loss takes place it is the result of one or more of three things. Part of the loss, and a considerable part at that, may result from soil erosion. In large measure it may be overcome through the application of wise land use practices. Nutrient loss may also take place through leaching which, though a natural process, is speeded up by improper husbandry and the depletion of the soil organic content. Substantial nutrient loss also takes place through their removal in crops and animal products. Where milk, beef, grains and other products are being sold off the farm nutrient depletion of the soil may be very high. This loss may be overcome to a considerable extent by the application of commercial fertilizer.

Not all soils have the same inherent fertility, nor do they possess the same resistance to continued cropping. The measurement of fertility depletion is difficult in a field survey and perhaps the best record is to be found in the individual returns for each farm. Individual farmers will know the productivity trend of their land. In most cases it is capable of substantial improvement.

CHAPTER 2

PRESENT LAND USE

1. PAST PATTERNS

Self-sufficiency was a prominent characteristic of pioneer agriculture in Southern Ontario. The essential requirements of life were produced, as far as possible, on the farm. Transportation facilities were often poor and goods carried long distances were costly.

Almost from the beginning, however, some type of cash crop was produced to obtain capital for future development and acquire those few goods and services that could not be provided on the pioneer holding. Lumber and potash were among the first "cash crops" of the pioneer. He exploited the accumulated resources of nature to carry him over until his land began to produce agricultural commodities.

Wheat and rye were two of the earliest cereal crops in the area of the Napanee. The emphasis was on spring rather than fall wheat, but today the pattern is completely reversed. In pioneer days much of the wheat was ground into flour and used locally. Rye, on the other hand, was largely a cash crop and much of the grain was sold for whisky manufacturing.

With an increase in numbers of livestock, hay and oats multiplied in acreage. Timothy hay was a prominent cash crop in the heyday of lumbering, since a large number of horses were used in the operations. The Napanee Watershed like many other areas in Ontario, benefited from this market. In later years clover and alfalfa have largely replaced grass as a hay crop. Alfalfa became common in the Mud Lake area about 40 years ago.

Several crops, which now occupy an insignificant acreage or are not grown at all, once enjoyed considerable popularity. Field corn was prominent in the 1870's and almost every farm had a few acres of this row crop, which was used for stock feeding. The decreasing labour supply contributed greatly to the decline of corn.

Flax was popular in pioneer days and extensively grown in the Moscow district. For a time, some was processed into cloth locally. Later, considerable quantities were sold for seed. Today this crop has almost entirely disappeared from the watershed. The same is true for hops.

Barley once held a prominent position in the agricultural economy of the area. Public demand for pale ale in the United States created a stimulus for barley production that lasted for about 50 years. The acreage in barley increased rapidly during the 1860's and 1870's and remained strong during the first decade of this century. In the early days of the barley era the grain was selling as low as 40¢ to 50¢ a bushel, but in later years reached a high of $1.50 a bushel. The coming of prohibition and stiff American tariffs brought about the decline of this grain as a cash crop, and today barley is mainly sown as a mixed grain with oats and used as a livestock feed.

Field peas were once extensively grown in the watershed and rivalled wheat in acreage sown. At the turn of the century this crop began to decline rapidly to an insignificant position. The recent introduction of canning crops, mainly in the southern section of the watershed, has brought about a minor revival in pea production.

Livestock have played an important role in the farm economy of the watershed from very early times to the present. Sheep were very important until the middle of the nineteenth century but have since undergone a steady decline in numbers. The decline in sheep production is attributable to a number of factors. The carrying capacity of the limestone plains may have decreased seriously as a

Sparse and rocky pastures are typical of the Shield.

Only a small acreage of cultivable land exists among the granite rocks of the northern portion.

result of over-pasturing. Dogs and wolves were also a menace to the stock in some areas. For many farmers, the complete switch to dairy cattle proved more profitable and more enjoyable.

Hog production has always been important in the area, but a decline set in from the high production of the mid-nineteenth century. During the war years production increased considerably, as it did over most of Southern Ontario, but the post-war period showed another drop in production.

Cattle breed preferences have changed considerably throughout the years. In the Moscow district the Ayrshire breed was favoured in early times. Durham cattle soon gained the ascendancy. With the development of cheese factories about seventy or eighty years ago, the demand for fluid milk increased. The cattle population rose quickly and the Holstein breed largely replaced Durhams. In the Moscow region Holstein cattle became very popular about 30 years ago.

2. PRESENT-DAY AGRICULTURE

In terms of the present agriculture, the watershed may be divided into two broad areas. These conform roughly to the two major geological areas. Conditions on the granite rocks of the Shield in the north stand in sharp contrast to those existing over most of the more southerly limestone area.

(a) PRECAMBRIAN SHIELD AGRICULTURE

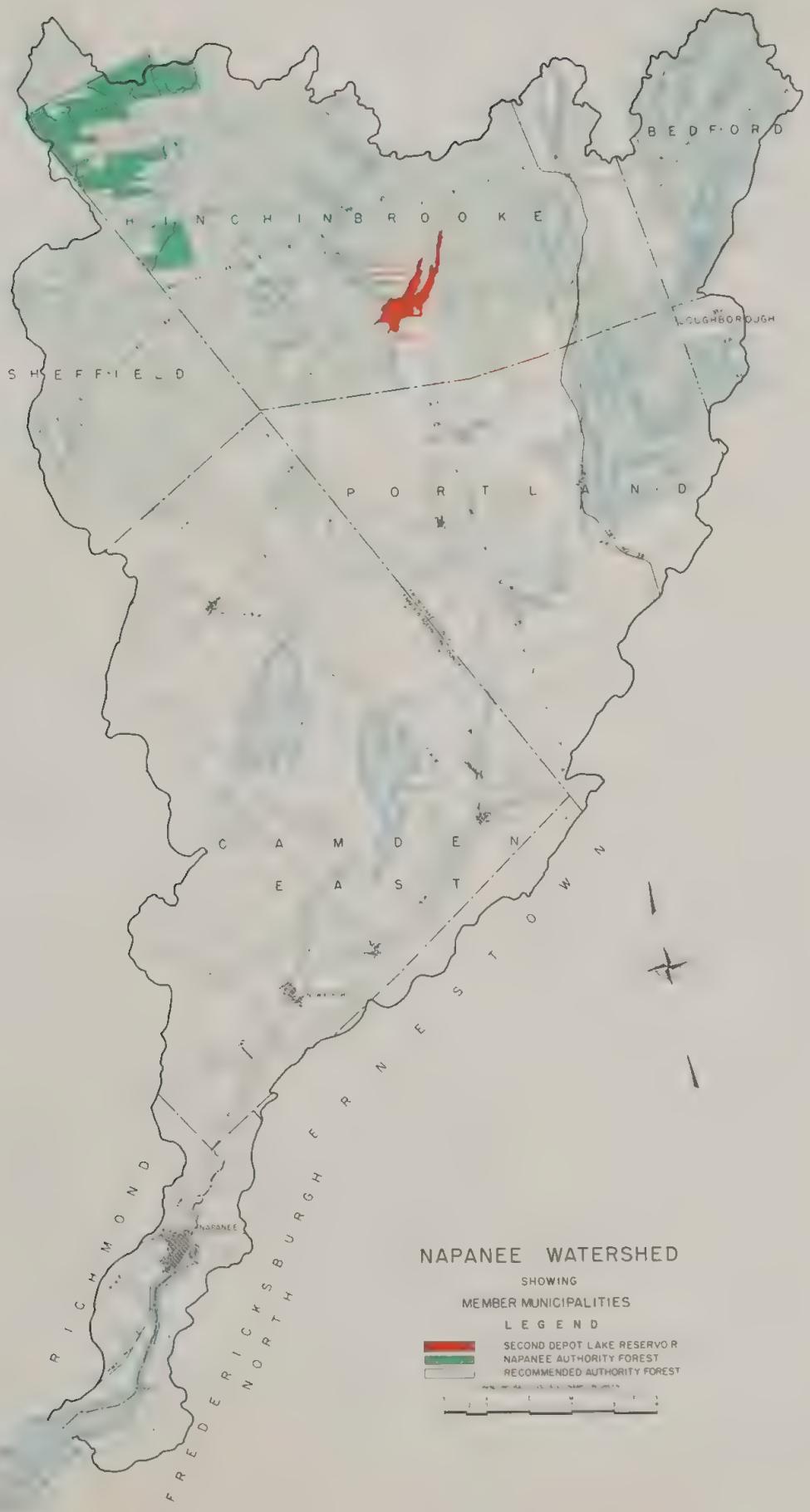
Agriculture on the Shield is confined largely to scattered pockets of deeper drift along the roads. The farm population is sparse and as scattered as the farm land. Relative isolation, even with the lack of many amenities, is welcomed by many of the rural folk and imposed on others. Most of the farms are owned but many homesteads have been abandoned.

Considering the low population the roads are kept in a satisfactory state of repair. The road net is highly incomplete however, and large areas are inaccessible for vehicular traffic. There is little doubt that municipal income from summer properties contributes greatly toward keeping some roads open and in good repair.

The total acreage of improved land is rather small and field crops occupy only a small fraction of this land. The great bulk of the land is too rocky, stony, wet or shallow to support a substantial agriculture although a large portion of it is used as range for cattle. There is considerable doubt that the income per acre from this form of use is as great as would be derived from a managed and protected woodland.

The main emphasis on the Shield is the production of livestock or their products. Beef and dairy cattle provide the chief source of agricultural income and are about equal in this respect. Beef production is more important in those areas where road access is poorer and the land must be considered as range rather than pasture. Swine and poultry are an important secondary source of income. Milk is shipped to Parham, Selby and Harrowsmith. It is reported that one producer ships whole milk to Toronto.

Wheat, barley, oats and potatoes are the main crops grown. Most of the pasture is unimproved and much of the hay is wild hay gathered from wet,


BEDFORD
HINCHINBROOKE
LOUGHBOROUGH
SHEFFIELD
PORTLAND
CAMDEN EAST
TOWNSHIP OF
RICHMOND
NAPANEE
FREDERICKSBURGH
NORTH
FRONTENAC
NAPANEE WATERSHED
SHOWING
MEMBER MUNICIPALITIES
LEGEND
SECOND DEPOT LAKE RESERVOIR
NAPANEE AUTHORITY FOREST
RECOMMENDED AUTHORITY FOREST

low-lying areas. There would appear to be greater opportunity for potato production on some of the larger light till and sandy areas.

(b) THE LIMESTONE AREA

The southern section of the watershed is more completely agricultural and the economy depends largely on livestock production and dairying. Although farm tenancy exists the land is predominantly occupied and farmed by owners. Where the soils are thin many farmsteads have been abandoned. This fact serves to indicate the low productivity of the land.

The increasing industrial development in Napanee and Kingston has opened up jobs attractive to many residents in the Napanee Valley, some of them farmers. There would appear to be an increasing tendency for some farmers to gain a high proportion of their income from non-farming activities. If this situation continues, and there is every reason to believe that it will, there will probably be a decreasing interest in those crops requiring a high labour input and an increasing interest in those crops requiring a minimum of labour.

In the southern portion of the valley, and along the Newburgh Road, cash crops, particularly raspberries, are produced on small holdings. Agricultural enterprise of this kind may be expected to develop.

Field crops occupy a high percentage of the land and, as on the Shield, the production is chiefly of livestock feeds and fodder. Only a very small acreage is devoted to commercial grain crops such as wheat and rye. Oats and mixed grains occupy a much larger acreage. By far the bulk of the improved land is devoted to hay and pasture; much of the latter is found on the thin-soil limestone plain and is unimproved and often incapable of much improvement because of physical land conditions.

Canning crops, chiefly corn, peas and tomatoes, and market garden crops have become more important in the last few years. The bulk of the canning crop is processed by Canadian Canners in Napanee, but some production also goes to the plant at Deseronto. The volume of production coming from the valley is small however, chiefly because most of the land suited to these crops lies beyond the confines of the watershed.

Dairy production is probably the mainstay of agriculture in the watershed and the milk finds several uses. Cheese factories at Tamworth, Selby, Newburgh, Moscow and Harrowsmith take a considerable volume of milk, as do dairies and creameries at Parham and Napanee. Skim milk powder is produced at Newburgh. Whole milk is also shipped to Napanee, Toronto and Kingston. The Acme Farmers Dairy condensery at Napanee takes a considerable volume.

As elsewhere in Ontario swine are an important source of revenue but production varies considerably with the market demand. A fair number of sheep are kept in both sections of the valley but generally speaking their importance is minor.

Poultry and egg production have been important in the valley for some time although there are few large producers. Live poultry shipments to the United States have been important at various times but the Canada Packers plant at

Cheese factory at Moscow.

Grass being cut for silage on the till plain near Hartington using modern equipment.

Grass from the carrier being blown into the silo.

Napanee probably absorbs the largest single part of the production. The largest concentration of birds is found in the Moscow area but the Lens-Centreville-Enterprise area is also important.

3. REGIONAL ORIENTATION

Although the valley is a hydrographic unit it is much less than that in terms of economic and social unity. This is true to some extent of all watersheds of course, but it is more true of the Napanee than of many where Conservation Authorities have been established. This fact should be recognized by the Authority and steps taken to create a public interest in the river and the lands which it drains.

Several factors are responsible for the diversion of interest away from the valley. The lack of a major flood problem on the river has not created a local interest in river problems which a recurring event such as this would do. The contrary phenomenon of low summer flow has resulted in much local attention, particularly in the lower portion of the valley.

The fact that such a large portion of the valley lies on the Shield is also important. The people in this area have little interest in, or connection with, the lower Napanee Valley. During the summer a considerable portion of the population is made up of summer residents interested only in recreation.

Markets and the road net are also important. Provincial Highway No. 38 connects Kingston with Highway No. 7 and traverses the eastern portion of the watershed. This results in a direct orientation of this area toward Kingston and most of the people in Verona, Hartington, Bellrock, Godfrey and so on rarely go to Napanee, Newburgh or that portion of the valley. In the west Tamworth attracts much traffic.

CHAPTER 3

LAND USE CAPABILITY

1. INTRODUCTION

The use capability of land depends largely on the climate and on the inherent characteristics of the land. Within limits which are not necessarily rigid man may modify some of these factors by draining, irrigating, fertilizing, land levelling, using better crop varieties and so on. In general, however, the nature of the land determines the general use to be made of it and suggests the kind of use which should be made of it. The farmer should always try to fit his husbandry to the land, not vice-versa.

The aim of conservation is to adjust the use and management of land to its capabilities. In this way the greatest long-run economic return will be obtained and the continued productivity of the soil maintained.

On many of the fields on most of the farms of Ontario the land is variable in quality because of changes in the soil itself, in slope, and in drainage. Most farmers know and appreciate the fact of these differences and many, by themselves or with technical aid, adjust use to capability. To bring about efficient use

of land each farmer needs to make an inventory of his land and its capability. Considerable assistance in this matter may be obtained through the Soil Advisory Service of the Ontario Agricultural College.

On a watershed such as the present one the Conservation Authority is vitally concerned with the question of land capability. Any program in which the Authority becomes involved should be carried on with thought to its effect on the land. The Authority should proceed on the principle of looking at the watershed as a whole and of planning present and future activities so that benefit accrues locally and over the whole watershed. To aid the Authority in their work the capability of the land for the whole watershed was judged and a map delineating the various classes of land prepared. A copy of the map accompanies the full report.

Land on the Napanee Watershed may be divided into two broad classes on the basis of its suitability for cultivation, and its unsuitability for this use. Within these two general classes several kinds of land, each requiring different use techniques, may be distinguished.

2. LAND CAPABILITY CLASSIFICATION IN TERMS OF RECOMMENDED USE

A–LAND SUITABLE FOR CULTIVATION

Class I –Unrestricted Agricultural Use

Land suitable for normal cultivation practices without any serious limiting considerations.

Class II –Restricted Cultivation

Land of lower capability than above due to shallow soils, lower fertility, susceptibility to drought and erosion and in some cases boulderiness.

Class III–Conservation Farming

This land is susceptible to moderate or severe erosion, or is already so affected and requires specific techniques to keep it productive.

The land is characterized by long, smooth slopes of between 4 and 10 per cent, which lend themselves to contour cultivation, strip-cropping, grassed waterways and, in some cases, diversion terraces.

Class IV–Drainable Land

This land requires artificial drainage, either tile or ditch, before yields can be improved.

B–LAND SUITABLE FOR PERMANENT VEGETATION

Class V –Pasture Land

Although occasional crops may be taken from this land it is best suited to permanent pasture. Existing woodland should be retained so far as possible, but should be properly managed for best yield.

Poor drainage, such as is encountered in the Cameron Swamp and large sections of the Canadian Shield, makes many areas unsuitable for normal agriculture.

Between the granite rocks muckland can sometimes provide fair hay if properly managed and not over-drained.

On the limestone plain many acres of pasture are being overrun with weeds, juniper and other unproductive shrubbery.

Many opportunities for farm pond construction exist on the limestone plain. Ponds should be deeper than this one if possible, and fenced for longer life. This would make an ideal pond of the dug-out type.

Steepness of slope, ranging from rocky cliffs to steep grades between 15 and 20 per cent, exclude agriculture from some sections. The kame terraces in the Napanee Valley are a good example of steeply sloping, gravelly and droughty land which would be best utilized for tree growing.

RECOMMENDED LAND USE

LAND CLASSES

Class	Acres	Per Cent
I	7,311	3.6
II	17,245	8.5
III	4,996	2.5
IV	11,082	5.5
V	13,257	6.6
Woodland	137,175	67.9
Water	10,880	5.4
	201,946	100.0

CHAPTER 4

CONSERVATION MEASURES

Summer drought and poor land are the two great factors limiting the general development of a highly prosperous and diversified agriculture in the Napanee Watershed. Partly as a result of this, the economy of the area is geared largely to the production of animals and animal products. Even in those areas where the soil is of sufficient depth and quality the farm economy rests on the production of animal products. Exception to this is found in the southern part of the watershed where the production of vegetable cash crops on the heavier soils is fairly common and important.

Because such a large portion of the watershed is used for range, cultivated pasture, hay and forest, there is no widespread problem of soil erosion. In those areas where deeper soils prevail and cultivation can be indulged in there is often serious soil erosion and fertility depletion. In these areas, such as around Moscow, Enterprise and in the Napanee Valley, it is imperative that the good crop land be maintained and improved. On these limited lands a successful agriculture depends.

It would appear that little improvement in the productivity of the thin soils on the limestone plain is possible. Not only is cultivation of much of this land difficult or impossible but drought is an ever-present hazard in late summer.

On the Shield the cultivable soils are limited in extent and haphazard in distribution. Swampy hollows, rough topography and a widespread surface bedrock effectively control and limit agriculture in this area.

Raspberries are an important crop near Napanee.

Truck gardening south of Napanee. Up and down hill cultivation aids erosion and should be discouraged.

In both of these areas broad-scale use of the land is limited to the production of natural pasture or forest. At the present time there is no doubt that such pasture as the land supplies is more valued than the forest production and little or no attempt is being made to improve the forest cover. The limestone plain seems well suited to the production of pasture but its carrying capacity in animals per acre should not be over-taxed. Large areas of it are heavily infested with weeds and brush and the Authority might well consider giving assistance in their removal. The over-all deficiencies of the Shield suggest that the bulk of this area would be better served in the long run if maintained under a managed forest cover.

On those lands of the watershed capable of cultivation, many measures may be used to arrest fertility loss and soil erosion and to overcome excessive soil moisture and water supply lack. These techniques have been developed over the years by agriculturists, conservation specialists and farmers themselves. They are designed to improve soil structure and fertility and soil-moisture relationships.

The improvement of the land on a farm may often be accomplished simply by changing the methods used. What was good enough in father's time may not be good enough today with its changing demands, shortage of labour and increased mechanization. In other cases more may be required than a simple change of method. Perhaps one or more fencelines should be removed to facilitate conservation cultivation, a line of tile placed to drain a wet spot, or some other measure installed. In any case the aim is increased productivity, better crops and animals, a better land and a saving in time and money.

To be assured that he is installing the correct measures and derives the most benefit from them the individual farmer should consult the Soil Advisory Service, Ontario Agricultural College, through his local Agricultural Representative, or the Agricultural Representative himself. It will often pay the farmer to have his farm planned by the farm planners of the Advisory Service. This service is provided free of charge.

The following conservation measures are a few of the more important ones which might be used to advantage in the watershed. There are many others which would find application in specific cases.

1. CONTOUR CULTIVATION AND STRIP-CROPPING

Contour tillage means the cultivation of land along the contour and at right angles to the slope. Easily contoured slopes are broad and smooth and possess a minimum of slope change or of surface drainage channels. The best installation of such measures may require the removal and/or relocation of one or more fencerows. When the land is tilled "on the level" each furrow or drill-row acts as a small dam to retain the run-off water, which is better able to be absorbed by the soil. It may not be possible to follow the contour exactly, but this should be done as nearly as possible. If the furrows or drill-rows are not on the line of contour, there is the danger of water accumulating in depressions behind the implement-formed ridge and breaking across it to cause rill or gully erosion. This may be overcome by careful tillage and by providing grassed waterways in normal drainage channels.

Strip-cropping is often carried on in conjunction with contour tillage. This involves the establishment of alternating crop strips across the slope. Some strips would be devoted to grain or intertilled crops, and the strips between would be in hay or pasture. By the use of such a practice any water which escaped from the cultivated strip and which carried soil with it would be checked by the grass strip, with the result that the soil load would be dropped.

Contour tillage not only helps to save the soil but saves money and time. Experiments in the United States have shown time savings of 10-15% and fuel savings of the same magnitude simply by working at right angles to the slope instead of up and down it. Experience in Ontario has been similar.

The amount of land suited to contour cultivation in the watershed is relatively small but there are many areas where its use would be beneficial. A great many of the drumlins, where the slopes are not too steep, could be cultivated in this manner to advantage.

2. CROP ROTATIONS AND COVER CROPS

All of the well-drained or drainage-improved cultivable land on the watershed should be managed using crop rotations suited to the soils and needs of the individual farm. Carefully planned crop rotations, skilfully carried out, constitute a major soil conservation measure.

A good rotation makes the best use of the soil and is so designed that there is ample return of organic matter either as green manure or as crop residue. The inclusion of legumes leads to an increase in the nitrogen content of the soil and provides much organic material.

Rotations should be worked out so that the land is kept under vegetative cover as much as possible. By so doing the soil is not so easily compacted and eroded by heavy rains and melting snow. Where it is planned to leave a field fallow, it is advisable to cultivate so that much of the crop residue is left on the surface.

The cropping program will vary from farm to farm and will depend on the farmer's needs and the soil. The rotation may be arrived at independently by the farmer and may be quite satisfactory, but greater assurance may be obtained by having a farm plan.

3. ARTIFICIAL DRAINAGE

The cultivable land of the watershed is not marked by widespread conditions of deficient soil drainage. There are, however, many fields where drainage problems exist. In many cases the areas involved are small and the trouble and expense of correcting the condition would be out of proportion to the benefit gained. Often, however, satisfactory relief may be obtained at relatively small expense, certainly small enough to be paid for in a short time in increased yield. Depending on conditions and requirements, weeping tile or open drains may be used.

To provide good outlets, the last few feet of tile drain should be of vitrified tile or corrugated metal pipe extended a few feet out into the ditch or stream.

A head wall to prevent back-cutting and an apron to prevent scouring and gully development should be provided. The open end should be screened to prevent the entry of animals.

Ditches should be provided with gentle side slopes to prevent slumping and the spoil banks should be spread out. Spoil banks left in the rough are unsightly, are unproductive and harbour weeds. So far as is possible, ditches should be fenced from cattle to prevent trampling, sedimentation and bank destruction.

4. PASTURE IMPROVEMENT

Although there is much pasture on the watershed which is incapable of satisfactory cultivation and improvement there is a great deal which may be so treated. As often as not, however, the pasture is relegated to the poorest of land and little or nothing is done to improve the quality or carrying capacity. Where good land is used the same is all too often true. The number of beef or dairy cattle or sheep that a farm may carry is directly related to the quality of the pasture. Pasture is a major land use in the Napanee Valley, not a minor one, and it should be given the attention worthy of its importance.

On the cultivable land some of the pasture has been in for so long and has become so thin and weedy that it would be desirable to reseed or renovate it. Specific recommendations for the preparation and seeding of pastures may be obtained from bulletins distributed by the Department of Agriculture. In addition the local Agricultural Representatives stand ready to help any farmer with his pasture problem.

Soil tests and the use of fertilizer should not be neglected in the building of better pasture. Further, it should be realized that the quantities and types of seed to be used will depend on the type of soil in the field and the use of the pasture.

Management after seeding is important in maintaining a high level of production and in ensuring that the best possible return is obtained after the expense of working, seeding and fertilizing. Outlays of this sort will be recouped probably only after three or four years, but beyond that time a higher return will be gained than if the pasture was unimproved. Periodic clipping helps to produce a thicker turf and a more even stand and aids in restricting the growth of weeds. A further factor in pasture management is that of ensuring, so far as is possible, that no over- or under-grazing takes place.

Where the soil is too rough, stony or thin to cultivate, probably little can be done in the way of pasture improvement. The clipping of weeds and the removal of unproductive brush are practices which might often be used to advantage.

The general field of pasture management in the Napanee Valley is open to investigation and the Authority might consider giving a lead in this field, either in co-operation with a farmer or on land acquired specifically for the purpose. Assistance and advice from the Agricultural Representatives and interested farmers' groups should, of course, be invited. Information on pasture management on the thin soils of the limestone plain would be particularly valuable.

5. FARM PONDS

A large portion of the Napanee Watershed is fairly well watered by surface streams and probably the majority of farms have access to a surface water supply. There are, however, numerous farms where this is not the case, particularly on the limestone plain in late summer, and the water supply problem can become acute.

Farm water deficiency can often be overcome by the installation of a farm pond suited to the needs of the farm and the physical site. The simple dug-out pond is most widely used in Ontario and is well adapted to those areas where the water table is not too far below the surface. In other instances a run-off or by-pass type of pond may be more suitable. Sometimes a pond may be spring-fed.

Not only do ponds supply the immediate needs of livestock but they may often be used for recreational purposes and, if the location is satisfactory, for fire protection. Depending on the type, they may also aid in the maintenance of the water table and stream flow.

Rather few ponds have been built to date in the valley and the nearness of bedrock to the surface is often a deterrent to their construction. Even on the limestone plain, however, there are wet areas where the soils are sometimes deep enough to permit satisfactory pond construction. Before a pond is built considerable thought should be given to the type required and the sites available.

The fact that so few ponds have been built may, perhaps, be due to the fact that many farmers are unaware that the Authority stands prepared to assist them in this matter. A progressive policy of public relations would do much to overcome this deficiency.

6. GRASSED WATERWAYS

In many places natural waterways cross a slope, and in the spring or after a heavy rain they may carry a considerable volume of water. Often, in fact usually, such a channel is cultivated with the rest of the field and receives no protection. This situation is ideal for gully development, and once started its growth may be rapid. Where such a course enters more level land at the bottom of a slope, considerable material may be deposited and a delta formed and the growth of crops restricted.

When such a channel is grassed, it is placed in permanent sod, with the strip wide enough to take care of any foreseeable water flow. The permanent sod reduces the speed of flow and the erosive action of the water and, if large enough, could be used as a source of hay or pasture. Grassed waterways greatly reduce the risk of gullying and they could be installed with benefit at many places.

7. FARM PLANNING

To most farmers the idea of planning is not something new; in some measure or other they plan the use and management of their land so that they know a year or so in advance what cultivation sequence they are going to follow. They plan for repairs to buildings, equipment, fences and so on. They plan so far as

they can the day to day and month to month work they are going to do, and much of it becomes routine. Planning, in short, is an essential feature in the life of the farmer as it is with anyone concerned about his future.

Although many farmers have a plan regarding the use to which they put certain or all of their fields, relatively few have had their farms planned so that the maximum use, consistent with the best use, is made of each piece of land. The object of a plan of this sort is to enable the farmer to get the most out of his land and at the same time to do it in such a manner that no damage to the land occurs. When a farm is planned each piece of land is judged according to its capability to produce, and various use recommendations are made. These may include pasture management, crop rotations to follow, woodlot management and reforestation, farm drainage, fenceline removal or relocation, or any other works and practices which would benefit the farmer and his land.

Planning does *not* need to be so rigid that there is only *one* recommended use or management for a piece of land of one class. Alternative recommendations may be made for a piece of land in a certain class. The first rule is to apply the easiest and cheapest remedy. The next thing that determines the choice of use is the relation of the field to the rest of the farm. Other factors apply, such as suitability for using powered mechanized equipment, or the distance from the barn and ease of access. The final determination depends on the crops and animals the farmer chooses to carry. The final plan, therefore, is the end result of a good many compromises and at each stage of preparing the plan certain choices have to be made.

In developing the plan a farm planner goes over the farm field by field and maps the soils as he finds them. He uses an aerial photograph as a base map. The soil series and types are identified and an estimation of the degree of erosion is made by examining vertical sections of the soil. The slope of the land is measured, using a hand level which gives slope as a percentage. A rise of four feet in a run of one hundred feet, for example, is a 4 per cent slope.

The occurrence of watercourses, either permanent or intermittent, with or without a definite channel, is noted, as are fencelines, stonepiles, springs, seepage areas, gullies or any other items of importance.

All of the information gathered is marked on the map, using symbols, and each piece of land of the same type with respect to soil, slope and erosion is delimited by a boundary line.

From the map of soil types and conditions a map of use-capability is prepared. Each piece of land is assigned to one of eight capability classes. On any one farm not all classes will necessarily be found.

The plan of the farm is then worked out with the farmer so that each field, or each piece of land, is put as nearly as is practicable to the use which fits the capability. Any systems of tillage or cropping or special practices to control erosion and water loss are applied where necessary. The fields and rotations are worked out so that there is the correct balance of pasture, fodder and grain to meet the requirements of the herd which the land can carry.

Before the planned rotations are put into effect it may be necessary to arrange a transition period in which the change-over from present cropping to the planned rotation is made without losing a year of cropping. Also, it may take a year or two to get special devices like grassed waterways and terraces in working shape. A time of transition such as this may also prove useful in providing a period during which any desired changes in the plan may be implemented.

In adjusting use to capability it may not be possible to outline fields exactly according to natural soil conditions. The inclusion of a small area of, for example, Class II land in a field which is predominantly Class I land may mean that this small area of land of lower capability will be worked as intensively as the Class I land. This is not strictly following the principle of "using each acre according to its ability", but is a compromise weighed against the possible cost of fence removal, difficulties of tillage and so on. In a plan, therefore, there may be found one or more small areas of one land class within a larger area of another land class.

Experience on a number of planned farms in Ontario has shown that, properly carried out, changes of use and methods of use of the land can pay substantial dividends. Using the land according to its capability and with integrated conservation methods helps to reduce erosion, increase water insoak and lower run-off, and increase soil fertility. Properly applied conservation farming methods help put more money in the farmer's pocket although they may, of course, require some initial outlay. Conservation farming is, after all, nothing more than good farming on a planned basis. It can and does result in higher yields, more animals per acre, lower costs and higher returns.

At the present time only 9 farms have been planned in Lennox-Addington and Frontenac Counties and the Napanee Authority can assist this situation materially by publicizing the fact that the Ontario Government, through the Soil Advisory Service of the Ontario Agricultural College, provides free farm planning surveys and assistance. The Authority should, of course, work in complete co-operation with the local Agricultural Representatives and farmers' groups.

CHAPTER 5

CAMERON CREEK SWAMP

1. LOCATION

The Cameron Swamp extends from Highway 38 to Cameron (Mud) Lake a distance of about 8 miles. It is a mile or more in width and covers about 8,000 acres.

2. REASON FOR THE SURVEY

The swamp was surveyed in the fall of 1956 to appraise its suitability for agricultural use.

3. PREVIOUS SURVEY

Prior to 1921 the Geological Survey of Canada made a survey of the swamp to determine its usefulness as a source of peat.

4. DESCRIPTION OF THE SWAMP

The present forest is of the hardwood type with soft maple predominating but elm and black ash intermixed. Where cutting of the forest has been complete, considerable shrubby growth may be found. By and large the forest floor is free from undergrowth of any kind, chiefly because of annual flooding and adverse light conditions.

In only a few places, notably at the northern end of Camden Lake and near Napanee Lake, is the forest cover naturally missing or poorly developed. These areas were not explored but it is believed the vegetation is composed chiefly of sedges, swamp grasses, cattails and the like. Wild rice may be locally important in one or more of these areas.

There are several ridge-like outcroppings of Precambrian rock in the swamp, particularly near Highway 38 and immediately west of the Frontenac and Lennox-Addington County line. The latter ridge is continuous well into the swamp but it eventually becomes beaded in nature with the small rock knobs projecting well above the surface of the peat.

Generally speaking the peat ranges in depth from up to 3 or 4 feet along the edge to over 20 feet south-east of Bellrock. Most of it is deeper than the aforementioned minimum. No attempt was made to determine the extent, nature and thickness of the mineral materials beneath the peat. In nearly every test a near neutral (pH 7.0) or slightly alkaline (pH 7.0+) reaction was obtained.

Through a considerable portion of the year the swamp is covered by water up to a depth of several feet. As already mentioned, this has a considerable influence in restricting the development of a forest understory. These natural conditions would appear to be unfavourable to wildlife generally and to certain species in particular.

5. POSSIBILITIES FOR AGRICULTURE

Other considerations aside, it is believed that a considerable portion of the Cameron Swamp, at least 3,000 acres, is suitable for agricultural use. The cost of development would preclude any use except the most intensive. The land would appear suitable for the production of truck crops.

6. DEVELOPMENTAL QUESTIONS

Although a part of the Cameron Swamp appears suitable in some respects for development as a truck crop area, there are other aspects of the question such as climate, water relationship and markets about which little is known.

CHAPTER 6

A RECOMMENDED PROGRAM

Taking the Napanee Valley as a whole the over-all pattern of land use is in keeping with the broad capabilities of the land. These forms of use are dictated in large measure by the physical equipment of the region, its location with reference to markets, tradition, and the general movement of the economy. As has been seen, minor changes in farming emphasis may take place from year to year and greater changes from decade to decade.

It is not envisaged that future land use will differ radically from that existing at the present time although there will likely be an intensification of present use forms in certain areas. There is a general trend toward larger farm holdings and fewer farms in Ontario and it is unlikely that the Napanee Valley will be unaffected in this regard. One may look, then, for farm abandonment additional to that which has taken place to the present time and the incorporation of these lands into larger holdings. The over-all population of the valley will slowly rise however due to increased industrialization in Kingston and elsewhere in the area.

A large percentage of the Shield portion of the watershed is basically unsuited to a full-time agriculture or, for that matter, any agriculture at all, and full-time farmers in this area will never achieve a satisfactory income from this source. Most of the farmers will, as now, depend on supplementary income from other sources to maintain a reasonable standard of living. This non-farm revenue will come from industry, local and distant, from the tourist trade in all its forms, from mining and other sources. It seems possible that a major future source of income will derive from forest production. The bulk of these lands are best suited to forestry and the Napanee Authority is to be commended for the aggressive role it has played in acquiring such land for this purpose.

In those areas of the Shield where use of the land for agricultural purposes is possible and desirable, more fruitful use of the land may, perhaps, be achieved through a greater integration of farm and forest production. "There is . . . the need of an educational programme to develop the art and philosophy of true

Cattle underpasses like this are common in the limestone country.

husbandry . . . husbandry must replace exploitation in the minds of the farmer, the forester, the wildlife manager and the all-crop husbandman. Combination or multiple-use husbandry of a satisfactory type must be developed." In the years ahead the Napanee Conservation Authority may do much to promote and help bring about this type of development on the Shield. Multiple-use husbandry of this kind has been in existence for many years in some areas of Europe.

In the southern portion of the watershed, agriculture is and will continue to be the main endeavour apart from possible industrial development. On some of the land it would be advisable to carry on a program of public and private reforestation or forest improvement and in these matters the Authority can accomplish a great deal through publicity, education and direct aid where this is deemed desirable and advisable.

Because of physical restrictions a large portion of the improved land is perhaps best suited to a grassland economy. Much of this grassland cannot be improved a great deal as things now stand due to soil conditions. Experimentation, however, may provide management methods applicable and profitable in this type of country. The Saugeen Valley Conservation Authority has acquired land for pasture experimental purposes and it is suggested the Napanee Authority consider doing likewise. It would be desirable to ascertain the cost of removing scrub growth where it exists, cultivation and seeding methods, desirable seed mixtures, and the benefits from fertilizer application. A program of this kind should be carried on with the full co-operation and assistance of farmers' groups, local agricultural authorities and agricultural product and implement dealers.

Most of the balance of the land may be considered cultivable. Compared to the size of the watershed, however, the available acreage is small and every reasonable means should be taken to preserve it from deterioration and improve its productivity. On the bulk of this land one or more management practices may be applied with benefit; on many acres satisfactory measures are already being applied but more can be done to the ultimate benefit of the farmer and his land.

Improvement of soil fertility, tilth and water relations may be achieved through the application of the correct types and amounts of fertilizer, through crop rotations, pasture management, contour tillage, drainage and all the other measures which help to produce a healthy land and farm economy. Not all of these measures are applicable, of course, on any one farm but on most farms one or more of them may be applied to advantage.

The Authority is also urged to explore fully the possibilities for development of a substantial portion of the Cameron Swamp for vegetable growing purposes. If this area does prove ultimately suitable for this type of use it could have an important effect on the economy of the area. As a body dedicated to the improvement and wise use of land and water resources the Authority would have a substantial interest in the area.

In the matter of conservation generally the Authority should seize every opportunity to publicize its activities and accomplishments. Promotion may be effected through the press, radio, television, schools, agricultural fairs and shows, and agricultural organizations.


FOREST

CHAPTER 1

THE FOREST

1. AT THE TIME OF SETTLEMENT

The forests of the watershed then were predominantly hardwood of which hard maple was by far the most abundant species. The maple forests contained much basswood, some beech and a considerable amount of white pine. White pine also occurred in pure stands on the sand areas. The forests at the extreme south end of the watershed were made up largely of white oak, red oak and shagbark hickory. The swamps on mineral soils were chiefly hardwood including white elm, soft maple and black ash. On the peat and muck areas they were largely coniferous woods with black spruce, cedar, tamarack and balsam predominating but with a fair admixture of white spruce and yellow birch.

Chestnut oak (*Quercus muhlenbergii* Engelm) definitely occurs in isolated patches at the south end of the Napanee Watershed; hackberry (*Celtis occidentalis* L.) is present on the bottom lands and red cedar (*Juniperus virginiana* L.) is fairly abundant in the extreme south end of the watershed.

There is an interesting account of a vessel being built of this material:

> "In the first year of the present century, there was built in the township of Marysburgh a short distance west of the Stone Mills a schooner of some celebrity.... It was made altogether of red cedar, a kind of wood formerly very plentiful along the bay, and which possesses a most agreeable odor and is extremely durable. The vessel was named the Prince Edward".

2. SINCE SETTLEMENT

The map of the Napanee River itself suggests lumbering, for a whole succession of lakes are named from First Depot Lake near Bellrock to Sixth Depot Lake near the headwaters. These names give the impression that logging operations, particularly for pine, were very extensive and fanned out over most of the northern part of the watershed.

The rate of the reduction of the forests through lumbering, settlement and fire was very rapid, as is shown by the Census of Canada figures.

Occupied farm land was 50 per cent cleared in Lennox and Addington in 1850; by 1910 only about 11 per cent remained in woodland and the amount has stayed fairly constant ever since, though the quality has been decreasing steadily due to cutting, grazing and fire.

The actual measurement of woodland area within the Napanee Watershed covered by the survey made in 1948 shows a total of 58,790 acres or 29 per cent. Nearly all the northern part is repeatedly burned by fire and is continuously severely overgrazed.

CHAPTER 2

FOREST PRODUCTS

1. EARLY POLICY

At first all timber on public lands was reserved for the British navy but after 1826 anyone was permitted to cut on ungranted lands on the payment of dues.

2. MASTING

The export of masts and spars was a thriving business as late as 1855 but reciprocity and railways brought an increasing trade with the United States.

3. SQUARED TIMBER

The squared timber trade commenced somewhat later than the mast trade, and was carried on simultaneously with it though it lasted longer.

The timbers were transported by the river, by teams or by railway to the lake and were built into huge rafts. The rafts were assembled at Deseronto and included timber from the Trent and Moira Watersheds as well as from the Napanee. The lumberjacks built shanties on them where they lived during the trip down to the timber coves at Quebec.

4. SAW MATERIAL

The first sawmill on the Napanee was erected at what is now called Thomson's Mills over 165 years ago and is reputed to have been the second sawmill in Upper Canada.

An old map of the area dated 1836 shows two mills in Napanee and nine in other parts of the watershed, including Strathcona, Newburgh, Camden East and Colebrook. In 1860 another map shows 25 mills, two of these very large. The mill at Strathcona, then called "Napanee Mills", turned out nine million board feet of lumber a year and the mill at Thomson's Mills produced three million board feet. Today, with the destruction of the forests, there are only four small mills operating and one of these is a portable mill.

A study of the Census of Canada returns of forest products of farms only, not for the whole of the two counties, reveals the various trends and changes in the lumber industry fairly clearly.

From 1870 to 1890 much of the timber was squared and measured in cubic feet. In 1870 other products listed were pulpwood, firewood, staves, lathwood, tanbark and masts and spars. Between 1880 and 1890 the peak production of nearly all items was reached, and squared pine alone in Lennox and Addington Counties ran to more than 400,000 cubic feet in 1870. In 1890 fence posts and telephone poles were added to the list of products, as were railway ties. In the census years of 1900 and 1910 squared timber was still recorded in cubic feet and logs were measured in board feet; staves, lathwood, masts and spars and tanbark disappeared from production in 1920.

In 1920, too, no squared timber is shown and even logs are no longer separated by species. The returns of the latest census covering the year 1940 show only two products of the forest individually and the rest are all listed together as

other valued at so many dollars. The one product which has persisted through the records is firewood, which in Lennox and Addington County has dropped from a peak of 126,281 cords in 1880 to 22,441 cords in 1940.

One or two interesting observations with regard to individual species may also be made. Tamarack was listed in large quantities regularly until 1890 after which it no longer appears, due to the depredations of the larch saw-fly which almost wiped it out at this time. The returns show that some black walnut, butternut and hickory were cut. White pine was, of course, the species most sought after. In 1870 and 1880, pine and oak were the only species which were squared, but as these species became scarce ash, birch, elm and maple were made into square timber.

5. SHINGLE MAKING

There was a concentration of shingle makers around Enterprise in the late 1850's and of "wood and willow ware" specialists at Enterprise about the same date.

In 1857 there were three shingle makers at or near Enterprise and the names suggest that these were separate establishments, since they are those of sawmill owners in the district at later dates (not at Enterprise). One shingle mill is listed in 1865 and one shown (near Carmanville) in 1878. There was a shingle mill at Petworth in 1869, which disappears later, and one in 1887 at Erinsville on the Salmon.

Possibly the supply of good cedar, which must have been abundant, petered out about 1870. Shingle mills in this district are rarely listed after that date, though there were many in other parts of the Province during the last years of the nineteenth century.

Up to the seventies and even later the shingle maker continued to use drawknife and frow, but gradually in the seventies the generation of craftsmen died out and the shingle mill, where shingles were sawn, became the general source of supply.

6. FUEL AND TIES

From the earliest days of settlement on the Napanee to 1850, wood was the sole source of fuel supply. All species were used for this purpose, including beech and maple—although these were furniture woods as well. With the inception of steamship travel and later the railway, and steam-driven factories, the forests of the area were ruthlessly cut to feed industry.

With the completion of the Grand Trunk between Toronto and Montreal in 1856, locomotive requirements took large quantities of the best body hardwood, chiefly beech and maple.

Since then the market for fuelwood has steadily declined as more and more people turned to other types of fuel.

7. ROAD MATERIALS AND FENCING

In the early days, the making of corduroy roads furnished another important wood use.

Big wheels, 6 to 7 feet in diameter and drawn by oxen, were occasionally used for logging on sand plains, the front end of the logs being slung from the axle. This pair, preserved by a local farmer, are the only ones known to exist in Ontario today.

A typical sawmill north of Newburgh.

Sawmill at Bellrock.

The building of plank roads—a form of highway in which the planks were laid crosswise and side by side—was done in several parts of the Province.

Much wood was also used for fencing and for this cedar from the swamps was most common. The troublesome pine stump also was used for this purpose in many parts of the Province, although in very early times it seems that it was left in the fields. Around 1900 the wire fence came into use generally and thereafter a fence-post industry was developed: these were cut as a rule to a standard length of eight feet, while the diameter varied greatly.

8. WOODWORKING AND PLANING MILLS

During the early years of settlement in the rural districts and communities, house trim for exterior and interior was made by the same man who constructed the frame of the house. The custom, up to the fifties at least, was for the carpenter to board with the family the winter before the new frame house was to be built and work all his timber into shape by hand, both for the exterior and interior use.

After the appearance of the planing mill in the fifties—there was a large steam planing mill at Camden East in 1860—the end of the hand-made door and window frames was foreshadowed, and much of the general carpenter's work was taken over by mill or factory.

9. WOODEN IMPLEMENTS AND VEHICLES

(a) EARLY TOOLS

From the very early days, hickory was preferred for the making of axe-helves or handles, while for beams or ox-yokes beech was used extensively and, for the loop, ironwood would probably have been selected.

As settlement developed and more craftsmen arrived in the area, the general types of agricultural implements improved and metal replaced wood in large part.

(b) VEHICLES

In 1860 there was a hub factory at Newburgh. Until 1929, when the factory burned, motor car wheels were manufactured at Yarker, most of which were supplied to McLaughlin's at Oshawa.

(c) PRESENT WOOD PRODUCTS

Today furniture is manufactured in Napanee by what is said to be the oldest furniture firm in Canada, established in 1835, and there are four manufacturers of small wood products. Brushes are made at Newburgh, clothes driers and boxes at Camden East and toys and crates at Yarker. Wooden pumps are still manufactured at Colebrook by a firm which began operations in 1870.

10. INDIRECT PRODUCTS AND BY-PRODUCTS

The three indirect products of greatest importance were maple sugar, lye and tanbark. Maple sugar furnished the staple sugar for the pioneers—cane sugar not, at that time, having been procurable; lye or potash was used domestically in making soft soap—almost the universal soap; tanbark was utilized in dressing leather by the shoemakers.

(a) POTASH

The ashery played an important role in the drama of pioneering life; and besides communal asheries, the individual ash house and the ash barrel on a platform for leaching was characteristic of each farm, in the days before the soap manufactory came into being. In 1860 there were two potasheries at Newburgh.

(b) MAPLE SUGAR

It is interesting to note that up to 1910 production is all recorded as pounds of sugar, from 1910 on both pounds of sugar and gallons of syrup were shown, indicating the change from a pioneer necessity to the modern luxury. When the returns of the quantities of sugar produced, as published in the census reports, are converted to their syrup equivalents, it is found that production in Lennox and Addington dropped steadily from the peak of nearly 26,000 gallons in 1870 to less than 8,000 gallons in 1940.

CHAPTER 3

PRESENT WOODLAND CONDITIONS

1. THE LAURENTIAN SHIELD (Rock Knob Uplands)

With the exception of lakes, marshes and limited areas which have been cleared for agricultural purposes, the whole of Sheffield, Hinchinbrooke and the north half of Portland Townships are potential forest land. This is the typical rock knob country of the Laurentian Shield with elevations ranging from 500 feet above sea level in the south to the extreme elevation of 825 feet in the south-east corner of Kennebec Township. The country slopes generally from north to south and consists of innumerable low rounded hills with countless small swamps and marshes between them. The depth of till varies from nothing over extensive areas where it has been washed off the rock following logging, fire and grazing to a few feet where the ablation moraine provides a thin layer of coarse-textured soil.

One factor which is helping to create and maintain what are becoming almost desert conditions over the northern part of the watershed is the large numbers of cattle which are permitted to range at will over the extensive unfenced areas of this northern section. In some instances the cattle are put out in the spring and run wild until fall, devouring all reproduction and young tree growth.

The forests of the northern portion of the watershed were originally a mixed forest of sugar maple, beech, yellow birch, hemlock and white pine. In addition, there were varying amounts of basswood, white spruce, balsam, red oak, elm, white ash, red maple, ironwood, white birch and poplar. White pine originally constituted a high proportion of the stand and red pine was also probably a fairly prominent species. Today the bush consists mostly of young growth and second growth poplar stands which have come in following fire and scrub oak which has survived the fire. Throughout the area there is a scattered growth of white pine on the well drained soils and the depressions support swamp species such as black ash, white elm, silver maple, tamarack, black spruce and balsam.

2. THE LIMESTONE PLAIN

South of the Laurentian Shield and south of the great swamp which bisects the watershed east from Enterprise, the watershed lies for the most part on the limestone plain. The exception is the narrow fertile valley of the Napanee River which has been cut into the plain. On the plain itself the soil is shallow, varying from no soil cover to depths which make agriculture possible. Over large areas the tree cover has been removed, the land has been severely overgrazed and the shallow soil depleted of humus and, exposed to beating rains, has been washed away into crevices. Wherever trees can, they put their roots down into these crevices and may develop quite thriftily. Such species as sugar maple, basswood, rock elm, white pine, white spruce and white cedar do quite well under such conditions.

The restoration of forest cover and duff to these areas presents certain difficulties but is essential to the maintenance of stream flow.

3. SURVEY METHODS

Field mapping was done on aerial photographs which were on a scale of 1,000 feet to the inch and each photograph covered an area of approximately 1,000 acres, usually a block lying between two adjacent concession roads and two adjacent side roads.

Every area of woodland, brushland, marsh, swamp and rough land was visited and notes made describing it. In the case of woodlots and plantations, detailed notes were made of their condition. Overgrazed woodlots and woodlots with very scattered trees which could be restored were classified as woodland. In short, where doubt existed as to whether an area should be classified as woodland or not, woodland was given the benefit of the doubt.

Stands were also grouped according to forest cover types. Where plantations were encountered records were made of planting, care, damage and survival.

4. FOREST COVER TYPES

The Napanee Watershed lies partly within the Huron-Ontario and partly within the Algonquin-Laurentides Sections of the Great Lakes-St. Lawrence Forest Region. The line separating these two regions is the edge of the Laurentian Shield.

In the Huron-Ontario Section, that is the southern portion on the limestone plain, sugar maple and beech are the dominant species and associated with them are basswood, white elm, yellow birch, white ash, red maple and red, white and bur oak. Groups of hemlock, balsam fir and white pine occur within the association as well as scattered aspen, bitternut hickory, butternut, ironwood and black cherry. Blue beech, silver maple, slippery and rock elm and black ash are found on specialized sites such as bottom lands and swamps. White pine is found on the lighter soils, red cedar is present on the limestone soils and white cedar in swampy depressions.

In the Algonquin-Laurentides Section, the northern part of the watershed on the Shield, white pine was originally abundant. Because of cutting and fire very little now remains and there is a secondary association of aspen, large-

toothed aspen, balsam fir, white spruce, white pine and scattered soft maple, red oak and ironwood. In addition to the above there are areas of pure hardwoods with a dominance of sugar maple; white and bur oak commonly occur and swamps of red maple, black ash or white cedar occupy the depressions.

The forest cover types occurring on the Napanee Watershed are:

NUMBER	NAME
4	Aspen
4A	Poplar–oak
6	Paper birch
8	White pine–red oak–white ash
9	White pine
10	White pine–hemlock
11	Hemlock
13	Sugar maple–basswood
14	Sugar maple
21	White spruce–balsam fir–paper birch
23	Black spruce
24	White cedar
26	Black ash–white elm–red maple
45	Bur oak
46	Red cedar
49	White oak–(black oak)–red oak
51	Red oak–basswood–white ash
52	Red oak
57	Beech–sugar maple
59	Ash–hickory
60	Silver maple–white elm
60A	White elm

Elm swamp types which covered large areas in the aggregate between ridges and in the glacial drainage channels have survived pretty well throughout the watershed. Cedar swamps which were scattered throughout the area have maintained their types well but have been severely overcut and pastured. Sugar maple types are still found scattered throughout the watershed. The chief pioneer types following cutting and pasturing are aspen types 4 and 4A which cover large areas, particularly on the Shield.

5. PRESENT CONDITIONS

Woodland on the watershed comprises 58,790 acres, which is 29 per cent of the total area of 201,946 acres. The total number of woodlots examined was 1,820 which includes many areas which are considered by their owners as constituting a single woodlot but which, because of the difference in types and age classes of certain sections, had to be considered in the field as separate units. Conversely, where property boundaries were not marked, woodland extending across two or more properties was often considered as a unit because the type and age class remained constant throughout.

The conifers occurring in the watershed are white pine, hemlock, white and black spruce, white cedar, tamarack, balsam and red cedar. Red cedar is confined to the extreme south end of the watershed as a very small tree. White pine is fairly generally scattered throughout the watershed. Hemlock is found mixed with hardwoods and white cedar and tamarack are present in many of the swamps. There is no doubt that conifers formed a larger part of the woodland than they do today, but their numbers have been diminished because of the desirability of the lumber they furnish and in the northern areas recurrent fires have destroyed them while more fire-resistant species such as oak have survived. The situation at the present time is that of the 58,790 acres of woodland 93 per cent is classified as pure hardwoods, 5 per cent as mixed woods and 2 per cent is classified as pure conifers. Of the hardwoods 71 per cent is second growth approaching commercial size and 22 per cent is young growth under four inches in diameter at breast height.

In the mixed wood classes 4 per cent of the woodland is of the second growth class while 1 per cent is young growth. In the coniferous woods 1.4 per cent is young growth and 0.6 per cent is second growth.

For the whole area the percentage of uneven-aged stands is considerably more than the even-aged, the figures being 84 per cent of the former and 16 per cent of the latter.

Grazing in farm woodlots is very general, the percentage of grazed woodland being 71 per cent for the whole watershed.

Fire protection is an absolute essential for the proper management of woodland in the watershed. It is recommended that now the Napanee Forest is established, fire-fighting equipment and sufficient personnel be provided to patrol the forest and fight fire when it occurs anywhere in the watershed.

Cutting in woodlots and clean-cutting of whole areas has been carried on persistently in recent years, many acres being sold for cordwood, and in other areas where white pine is found it is being cut into sawlogs of small sizes.

To sum up, 76 per cent of the woods are second growth and 24 per cent are young growth, the former ranging from thirty to fifty feet in height. The few lots containing the largest trees are composed of old hardwoods, elm, soft maple in the swamp areas and sugar maple, beech and basswood on dry sites.

From the foregoing it will be seen that the wooded areas of the watershed are extensive, comprising some 58,790 acres, and are worth preserving and improving. No systematic method of cutting has been used in the past, no attempt has been made to combat fire and none of the woodland is fenced from cattle.

CHAPTER 4

FOREST CONSERVATION MEASURES IN PROGRESS

Very few watersheds in Southern Ontario have such a high proportion of potential forest land as the Napanee and yet little or nothing has been done either to preserve what woods there are or restore trees to the denuded areas.

For example, there is no fire protection of any kind, there are no county forests, no demonstration woodlots; only two small township plantations and two small private plantations.

For some years now, the Department of Lands and Forests has divided Southern Ontario into zones, each with its "Zone Forester" whose duty it is to give advice and assistance to private individuals and municipalities on the management of their woodlands and the establishment of plantations. The Napanee Watershed is included in the zone covered by the office at Napanee. Citizens and municipalities would be well advised to make more use of these services.

The nearest forest tree nursery to the Napanee Watershed is that at Orono, in Durham County, which was established in 1922 and has served as the production and distribution centre for trees in eastern Ontario ever since. In addition, it contains a number of excellent demonstrations of forest planting of different species and mixtures.

1. PRIVATE PLANTING

The free distribution of trees for planting was first begun in Ontario in 1905, and the following year a statute was passed which enabled a township council to exempt a part of the woodland of a farm from taxation. In 1927 the exemption of taxation on woodland was made compulsory if applied for, and is interpreted as meaning planted as well as natural trees. In 1938 The Assessment Act was amended to prevent assessment being raised on land after it had been reforested.

Both these Acts were designed to facilitate the planting of trees on private land and should be taken advantage of by citizens anxious to improve woodland conditions on their own property, and at the same time benefit the whole community of the river valley.

There are only two small private plantations comprising 8 acres in all.

2. COUNTY AND AUTHORITY FORESTS

Lennox and Addington County purchased three blocks totalling 500 acres along the Old Flinton Road in 1948-49. The trees are growing well and serve as a small beginning of a county forest, but none of it lies within the Napanee Watershed.

Both County and Authority forests may be put under agreement for management with the Department of Lands and Forests for a period of, usually, 50 years.

At the end of the period, the Authority or county as the case may be, has the privilege of exercising one of three options: *First*, to take the forest over from the Government and pay back the cost of establishment and maintenance; *second*, to relinquish all claim to the forests, whereupon the Government will pay back the Authority or county's share of the cost of the land, without interest; *third*, the forest may be carried on as a joint undertaking by the Province and the Authority or county, each sharing half of the cost and half the profits.

The difference between the two types of agreement is:

1. The county pays the full cost of the land while the Authority pays half the cost and the provincial government pays half.

2. The county does not pay taxes on the land whereas the Authority does pay taxes.

The Napanee Authority has already acquired 4,379 acres of land for the Authority forest but 82,750 acres in all have been recommended for acquisition in a long-term project.

3. MUNICIPAL FORESTS

The Township of Camden East is the only township which has established a municipal forest. This township has made a small beginning by reforesting 13 acres in two blocks west of Yarker. The first trees were planted in 1939, and survival over most of the larger block of ten acres has been good. The plantation on the smaller block, however, has been almost completely smothered by weeds and considerable damage has been done by cattle.

4. DEMONSTRATION PLANTATIONS

No demonstration plantations have been set out within the watershed, though the value of these in showing landowners what can be accomplished in a very few years by planting trees is so great that every township should endeavour to establish at least one plot.

5. DEMONSTRATION WOODLOTS

Demonstration woodlots are privately owned areas of woodland on which the owners have agreed to follow prescribed methods of woodlot management outlined by the Department of Lands and Forests, under the Zone Forester, and to permit access to the area by interested persons. There are no demonstration woodlots on the Napanee Watershed.

6. TREE FARMS

In the past few years a movement has been under way to recognize well-managed forest properties as Certified Tree Farms. With the sponsorship of several organizations interested in better forestry, the Canadian Forestry Association in 1953 formed a National Tree Farm Committee to recognize with a suitable sign and certificate those owners who agree to maintain their land for growing forest crops, protect the land adequately, agree that cutting practices will be satisfactory to ensure future forest crops, and permit inspection by Committee foresters.

Several Conservation Authorities have become co-sponsors of the Tree Farm movement in their areas, and it is recommended that the Napanee Valley Conservation Authority give its support to this movement.

7. 4-H FORESTRY CLUBS

These clubs are organized by the Ontario Department of Agriculture assisted by the Department of Lands and Forests and must be sponsored by an organization interested in the improvement of woodland and reforestation.

Members must be between 12 and 21 years of age and each member undertakes a project such as marking a half-acre plot of woodland for thinning or reforesting a quarter-acre of land. Projects are judged annually on Achieve-

In the granite country the hard, ice-scoured bedrocks at the surface prevent the development of a substantial agriculture. Note the Cameron Swamp in background.

After the spring runoff most of the minor streams in the limestone country dry up.

ment Day and prizes awarded; for this purpose the Department of Agriculture furnishes $3 per member, and the sponsoring organization, $1.50. Winners may enter the Provincial Inter-Forestry Club Competition.

To date none of these clubs have been formed in the Napanee Watershed.

CHAPTER 5

FOREST CONSERVATION MEASURES REQUIRED

1. REFORESTATION LAND

The most important conservation measure required on the Napanee Watershed is the restoration of forest cover on the greater part of the Rock Knob Uplands which cover the northern part of the watershed. This is a rocky area of country covered with sandy till of varying depth. Some of it has been cleared for agriculture and is suitable for the production of crops, but the greater part of it is suitable only for the growing of trees. Repeated fires have swept over it, cattle range over most of it devouring the few seedlings which do establish themselves, and most of the area is so prevented from becoming productive. The establishment of an efficient fire protective system as recommended elsewhere in this report would do much to rehabilitate the region, but reforestation of much of it is also required.

Part of the area, particularly the rockier sites, is still owned by the Crown, and it is recommended that the Authority approach the Provincial Government with the object of acquiring this land and placing it under agreement for management.

The remainder is in private hands and a progressive policy of reforestation should be inaugurated whereby lands would be acquired by the Authority as they become available either through tax sales or are put on the market at a reasonable figure.

In the southern part of the watershed there are a number of areas where the restoration of forest cover is necessary to a co-ordinated conservation program for the watershed.

It is recommended that over a period of years the Authority acquire a total of 82,750 acres as an Authority Forest.

In addition to the large areas of limestone, moraines, igneous rock, sandy land and shallow soils, there are innumerable smaller areas forming parts of farms which will always be in private hands. The aggregate effect of this on stream flow is very considerable. These should be planted with trees to form part of the farm woodlots where they occur. Many of them should be placed under a reforestation and controlled woodlot scheme by the Authority, especially where they cover the sources of streams. Under this scheme the owner would get considerable help from the Authority in the establishment and maintenance of the woods, but would not be permitted to cut them indiscriminately.

White pine, white spruce and balsam grow well even on the shallow soils of the limestone plain.

In spite of the shallow soil white cedar, white pine and common juniper will grow and maintain cover if they are protected from fire and cattle.

Sugar maple, basswood and rock elm will put their roots down into the crevices in the rock and produce worthwhile timber on soils too shallow for other crops.

2. WILLOW SCRUB AREAS

In addition to the rocky land there are about 3,000 acres of scrub land. This is mostly poorly drained land covered with scrub willow and alder, though in the south end there are some fairly large patches of prickly ash (*Zanthoxylum americanum*), sumach and hawthorn. The willow scrub areas present a problem in planting and research should be undertaken to determine the best method of handling them. There appears to be a natural succession from neglected pasture land through willow scrub, trembling aspen, white elm and black ash to the climax types of silver maple-white elm or black ash-white elm-red maple and every effort should be made to determine the best method of speeding up this succession.

3. CONTROLLED WOODLOT MANAGEMENT

Before the necessary conservation measures on that part of the watershed, exclusive of the proposed watershed forest, can be properly co-ordinated, some system of controlled cutting of privately owned woodlots must be worked out. The establishment of a minimum diameter limit for cutting is a step in this direction.

4. FENCING WOODLOTS FROM CATTLE

A worthwhile attempt at forestry action in Southern Ontario was the step taken by the County of Halton in 1948, when the County Council passed a by-law to aid farmers in fencing their woodlots from livestock.

The by-law as revised in 1949 states that the County of Halton will grant a sum equal to the cost of the fence wire to a woodlot owner who will erect such a fence on one or more sides of his woodlot in order to completely enclose the woodlot, thus fostering forest growth by keeping livestock out. The woodlot must be of a size not less than two acres and livestock must be excluded for a minimum period of twenty years.

Such action by the County Council is commendable and it is recommended that the Napanee Valley Conservation Authority, through discussions with woodlot owners, should formulate some modification of this program which will stimulate action toward the elimination of woodland grazing and the improvement of private woodlands.

5. DIAMETER LIMITS

The basic method of control of cutting usually advocated is cutting to a diameter limit, that is, that all trees below a certain diameter (for example fourteen inches) should not be cut. Such a regulation may or may not be good forestry. In most cases it would not be, because there would be much worthless material below this diameter limit, such as poplar, thorn, willow and other species, which should be taken out. At the same time, there would be certain large trees above the diameter limit which should be left for the benefit of the forest, as well as trees suitable for re-seeding the area. The diameter limit should not be a fixed rule, but simply a guiding principle; a sort of yardstick, on which the landowner can base his calculations.

Twenty-five counties have passed by-laws under The Trees Act (R.S.O. 1950, c. 399) which empowers the council of county to pass by-laws restricting and regulating the cutting of trees. In each case the by-law has fixed minimum diameter limits below which trees may not be cut except in special circumstances. The object of this is to prevent the cutting of trees at the time when they are putting on their greatest diameter growth. These limits are usually 5 to 8 inches for white cedar, red cedar and black locust, and range from 10 inches to 16 inches in the various counties for all other species. The limits which have been set are actually far too low for good forestry practice as most trees are making their maximum diameter growth after they reach 18 inches in diameter, but it is an elementary step in the right direction.

6. FOREST FIRE PROTECTION IN SOUTHERN ONTARIO

In 1957 the Tweed Fire Protection District was extended to include the townships of Kennebec, Sheffield, Hinchinbrooke and Bedford.

Chestnut oak (Quercus muhlenbergii) is a rare tree in Ontario but a few trees may be found growing naturally in Fredericksburgh Township.

However, it is recommended that the Authority investigate and urge the implementation of the best methods of providing fire protection in the southern portion of the watershed in co-operation with the Department of Lands and Forests.

CHAPTER 6
FOREST INSECTS AND DISEASE

In any project such as that proposed for the watershed, careful consideration should be given to the prevention of insect outbreaks and tree diseases and arrangements made for control measures when necessary. There are a number of fundamental principles which will greatly lessen the destructiveness of these pests which are set forth in the full report.

CHAPTER 7
LAND ACQUISITION

The only part of the watershed where large-scale transfers from private ownership to the Authority would have to be made are those areas which are recommended as reforestation land. The best farms in these areas need not be entirely withdrawn from agriculture, where upkeep of public utilities is not too heavy. They could be incorporated in the forest as farmland and used by forest workers, since both farming and forest work are seasonal to some extent.

There are several methods of acquiring land for conservation purposes. It may be transferred to the Authority by ordinary private sale, a maximum price per acre beyond which the Authority is prohibited to go might be set, or in some cases long-term agreements could be made with the owners for control of such parts of their lands as fall within the forest scheme. As a last resort, the Authority has the power to expropriate land for conservation purposes under The Conservation Authorities Act.

CHAPTER 8
SNOW FENCES

Much of the cost of controlling drifting can be eliminated by substituting permanent hedges of trees in place of snow fences. In addition to preventing drifting, snow hedges furnish many of the conservation benefits of windbreaks but on a reduced scale because of their lower height. Every encouragement should be given to their establishment.

CHAPTER 9
WINDBREAKS

In the process of clearing land for agriculture, woodlots and belts of trees along fence lines have been removed which served as natural shelterbelts. The restoration of these in the form of windbreaks is essential to a complete conservation program.


WATER

Napanee River at Camden East, in late summer.

Napanee River at Springside Park, Town of Napanee, showing typical stagnant pools due to low flow conditions.

CHAPTER 1

GENERAL DESCRIPTION OF THE WATERSHED

1. MUNICIPALITIES

The Napanee Valley Conservation Authority comprises eleven municipalities and the population of each living within the watershed is:— Bedford 106, Camden (East) 1,724, Ernestown 171, Fredericksburgh (North) 390, Hinchinbrooke 534, Loughborough 56, Portland 1,717, Richmond 216, Sheffield 322, Napanee (Town) 4,232 and Newburgh (Village) 554, with a total of 10,022.

2. DIMENSIONS

The Napanee Watershed has an area of 316.3 square miles. It is triangular in shape funnelling into the Bay of Quinte at its junction with Long Reach. It extends north from the bay about 32 miles. Its greatest width east and west is 18 miles at the upper end narrowing to 2 miles at the town of Napanee which is astride the river five miles upstream from the mouth.

3. THE RIVER AND TRIBUTARIES

Compared to other watersheds in Southern Ontario the Napanee is unique in that it is studded with lakes and connecting streams. The sources of the Napanee River are three main tributary streams, namely: the Depot River, Hardwood Creek and Cameron Creek with its tributary Carmen Creek. The Depot River and Cameron Creek join one mile south of Bellrock and flow into Napanee Lake which also serves as the outlet for Hardwood Creek. The Napanee River proper is from the outlet of Napanee Lake to the Bay of Quinte.

The Depot River is the most important of the above tributaries because it contains a chain of lakes many of which have potential conservation storage. There are six Depot Lakes in the chain, numbered consecutively northward from First Depot Lake, near Bellrock, to Sixth Depot Lake. Another lake in this chain is Wheeler Lake at the headwaters. Fifth Depot Lake has other small tributaries draining directly into it which rise in five small lakes near the boundary of the watershed.

4. PHYSICAL CHARACTERISTICS AND THEIR EFFECT ON THE INHABITANTS

The lower part of the drainage basin lies on limestone plains, whereas the northern part of the area covers the rocky knobs of the Precambrian Shield. The physical and chemical characteristics of the water and the manner of run-off from within the watershed reflect the pattern of the underlying rocks.

In general the land is rough and the portion of the drainage basin lying on the Precambrian Shield might well be thought of as undeveloped. In this area all the original timber has been cut or burned, and only in the scattered pockets of the granite outcroppings do sufficiently large soil areas exist to attract even the most frugal farmers. The lower part of the basin, located in a region of Paleozoic rocks, has a varying depth of soil cover and, generally speaking, is reasonably fertile land. There are a few industries in the hamlets which border the stream, although at one time many small mills thrived on the power of the river.

These industries passed on as the stream flow diminished as a result of the opening up of the upper river to farming practices. In earlier times logging dams and the forest-clad reaches of the upper river had helped to stabilize the flow in spring, summer and fall. The cutting of the forests, the draining of the swamps and the removal of the dams has led to rapid run-off and low summer flow.

No large centres of population exist on the Napanee River. The largest municipality is the town of Napanee which uses the stream as a source of water supply and hydraulic power to operate its water supply system. As already shown there are several hamlets and small villages of which only Newburgh is incorporated.

Although many floods are recorded in Chapter 2 they do not constitute a serious flood problem. On the other hand the development of the stream has led to it becoming a mainstay of existence of the population within the Napanee River Valley. The need for action for water supply, for power development, and for improved recreational facilities is most apparent. The present trend toward improved transportation is leading to a further denuding of the already barren northern area, to the further draining of swamps and thus to further poverty and hardship for those along the entire river. At the present time, there is insufficient river flow in the summer to warrant the capital investment required to support additional industry. It is quite evident that the prosperity of the little mill towns along the stream is intimately connected with the dependability of the stream, and as these communities flourish so do the farmers in the surrounding townships prosper. Action should be taken, therefore, to sustain summer flow through the building of storage dams.

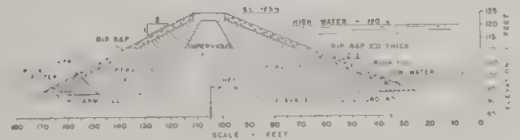
CHAPTER 2

FORMER FLOODS

Present-day knowledge of the severity and frequency of former floods in any part of the Province of Ontario depends upon two things: the care with which such floods were originally recorded, and the preservation of the records for present-day study and examination. In the early days of the settlement of the Province, only the occasional diarist or letter-writer took any pains to set down in writing the record of events; and, as a rule, his observations were limited to his immediate vicinity, and to within a few days of the actual occurrence of the events. It so happens that, in some parts of the Province, careful and consistent records were thus made of floods and other occurrences, in the years before 1800; and that these records have been preserved to the present day. In the neighbourhood of the Napanee Watershed, such records are lacking.

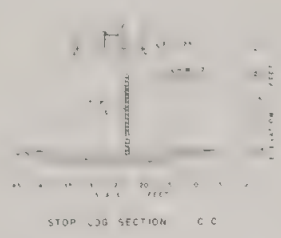
Champlain visited the Napanee and the Bay of Quinte in 1615, in the months of September and October, at a time of year when floods are least likely to occur; he recorded no floods. The first to explore the shores of the Bay of Quinte for the first wave of Loyalist settlement was Lieutenant Solomon Johns, in 1783; his observations were made in the month of October, and he observed no floods.

PLAN OF RESERVOIR

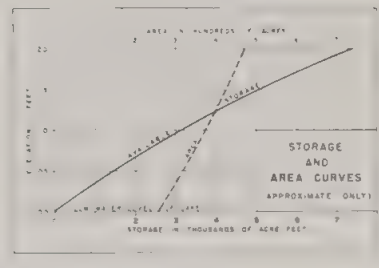


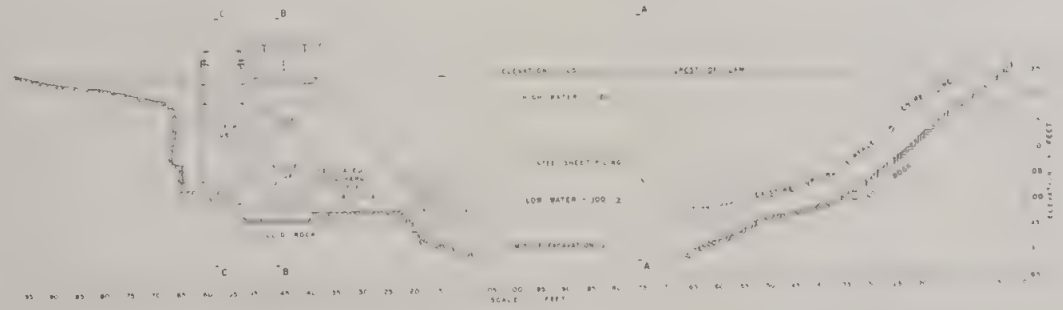
EARTH DAM SECTION - A-A

SLUICE GATE SECTION B B



STOP LOG SECTION C C





DOWNSTREAM ELEVATION

SECOND DEPOT LAKE

DAM AND RESERVOIR

SHOWING

PLAN OF RESERVOIR

SECTIONS AND ELEVATION OF DAM

STORAGE AND AREA CURVES

SCALES AS SHOWN

NOTE - ELEVATION DATUM WATER LEVEL UNDER BUSHES BRIDGE AT DAMSITE OCT 10, 1949 WAS ASSUMED AS 00.00
BENCH MARK NO 3 - CROSS ON TOP OF N W ABUTMENT OF BUSHES BRIDGE — ELEV 113.03

Whatever may have been the reason, for more than fifty years after the coming of the first Loyalist settlers, there was no record made of floods on the Napanee or its tributaries, that has come to the knowledge of the writers of the present report. As it seems reasonable to suppose that spring freshets and summer flash floods did, from time to time, occur in the watershed, the explanation of this lack must be one of the following possibilities: (1) Floods were not observed, or, if observed, were not recorded; (2) Records of floods were made, but not preserved; (3) Records have eluded the search of present-day investigators.

The earliest known record of the occurrence of floods on the Napanee is found in the Journal of the Travelling Missionary of the Church of England for the year 1835, and has reference to the rear concessions of the Township of Camden East, and the adjacent parts of the Township of Sheffield. In his journal of the 20th and 21st of October, 1835, the Rev. W. F. S. Harpur wrote:

> "On Tuesday (20th) I proceeded into the back concessions of Camden, and the next day (21st) continued my journey into Sheffield. Travelling had now become very tedious; the roads in many places being rendered almost impassable by the late heavy rains—some of the bridges having been carried away, and many of the causeways overflowed."

It is evident that, along the route of his journey, Mr. Harpur witnessed a flood condition of considerable severity, by which "some of the bridges" were washed away. What the corresponding conditions may have been in other parts of the watershed can only be guessed.

Forty years were to pass before the next well-authenticated report of a severe flood on the Napanee found its way into permanent record. In 1875, there was a flood on the main stream of the Napanee, severe enough to cause a considerable amount of damage. The report was published in the Toronto Globe, Saturday, April 3, 1875.

> "Napanee, Apr. 2.—The ice in the Napanee River is commencing to break up, and great damage to bridges is anticipated. The north half of the bridge crossing the river to Brownstown was carried away last evening (April 1st) by ice, and a gang of men have been at work today breaking the jams of ice and clearing a channel, as fears are entertained for the safety of the new swing-bridge crossing the river to Fredericksburg. Reports come in of a number of bridges that have been carried away on the roads leading from this place. The water is still rising very rapidly.
>
> "Newburgh, Apr. 2.—The ice in the River broke loose yesterday (April 1st) at noon and rushed downstream in cakes weighing tons. Swept away part of W. H. Eakin's dam, completely demolishing his race. Large cakes of ice now lie on the banks, carried down with the rush. The jam was one time eighteen feet high. Fears were entertained that two bridges would go down stream. The danger is not over."

Despite the suggestions of threats of further danger contained in these dispatches, and the extent of damage already incurred, the newspapers of the ensuing week give no hint of the progress of the floods during the week-end, and make no further mention of the amount of damage done.

In the following year, 1876, according to Mr. George Anson Aylesworth, a life-long resident of Newburgh, a flood carried away one of the bridges by which Main Street, in that village, crosses the Napanee River. All that is known of this flood is contained in a single sentence, written by Mr. Aylesworth, and published in the Papers and Records of the Lennox and Addington Historical Society, Volume 2 (1910), page 33:

> "In 1876 the bridge carrying Main street Newburgh over the larger branch of the Napanee River, was swept away."

Ten years later, in 1886, spring floods on the Napanee River "caused considerable damage in Napanee and the county of Lennox." The severity of the floods and the extent of the resulting damage may be judged by the account published in the Toronto Mail, Friday, April 2, 1886. On Wednesday, March 31st,

> "the flume of Craig's grist mill in this town (Napanee) was burst, causing a suspension of operations in the mill. As repairs cannot be made till low water is reached, the loss will be considerable. The foot bridge below the Napanee Falls was completely carried away, and the swing bridge was badly injured, the centre pier being moved three feet down the stream by the pressure of floating ice.
>
> "At Napanee Mills (Strathcona) a bridge was lifted off the piers and floated downstream. In North Fredericksburg two bridges were swept away. At Odessa two dams were broken and three or four bridges in the county were destroyed. At other points more or less damage was done. Traffic on the Napanee, Tamworth & Quebec Railway was suspended today because of a number of washouts, but it is expected trains will be through tomorrow."

A few brief notes will suffice to indicate the relatively unimportant floods that occurred during the fifty years following the floods of 1886.

In 1913, a flood was caused in Hinchinbrooke Township by the malicious dynamiting of a dam on April 16th. As a consequence, one man was drowned, attempting to cross the Fifth Lake Bridge.

A photograph, a copy of which is in the offices of the Ontario Department of Planning and Development, said to have been taken in 1928, shows water and ice over the Newburgh Road, at Mink's Bridge. The date has not been confirmed, and other authentic information is lacking.

On January 18, 1929, and again on February 11, 1932, heavy rains resulted in the flooding of many cellars in the Township of Camden East; but it is not recorded that any part of the river or its tributaries overflowed the banks.

According to a Report of the Canadian National Railways, dated December 19, 1950, a flood on an unnamed tributary of the Napanee River, in March, 1933, caused a washout between Napanee and Strathcona that resulted in the derailment of a train.

Whether these were the only occasions in the years between 1886 and 1936, when there were floods on the Napanee, cannot with certainty be known. It seems likely that there have been other times of high water, possible overflow and resulting damage to property; but there is nothing to indicate that such

damage has at any time been severe. A close study of the records points to only one sure conclusion, namely, that the records are decidedly meagre and inadequate.

In 1936, two severe floods occurred, the one following hard on the heels of the other. The first of these took place on March 11th, when heavy rains and a sudden thaw brought on a greater freshet than the natural watercourses could accommodate. The Napanee Beaver of March 18, 1936, gave the following account of the freshet.

> "It is many years since the Napanee River broke up so early and so suddenly. The result was that ice jams formed around the bridge piers and water was dammed back and overflowed the river banks, flooding the surrounding districts.
>
> "During the night on Wednesday (11th), a washout occurred on the C.N.R. Ottawa line, not far from Mink's Bridge on the Newburgh Road. . . . At Mink's Bridge, on the Napanee River, the ice formed a jam, which dammed the water back, bringing it up to the level of the floor boards of the bridge and causing it to overflow the road to the east approach to a depth of about two feet.
>
> "In Napanee, the ice in the pond above the falls went out about midnight on Wednesday (11th), and the water raced down the falls in a raging cataract. The level land on which the bathing houses are situated, was completely submerged, and the bathing houses were about half under water. Water was rushing over the retaining walls near Springside Park and was flowing down through the park. At the swing bridge, at the foot of Centre Street, an ice jam of chunks of ice about three feet thick formed, and the water rushed through under the bridge as if the river at this point was a rapids. Some fears were expressed for the safety of the bridge on account of the tremendous pressure of the ice and water on the piers.
>
> "The canal which feeds the water filtration plant was overflowing its banks all along its course and water was rushing down the roadway nearby and into the pumping plant through the doors.
>
> "On Wednesday evening the water in the natural watercourse, which flows just west of the Old Belleville Road and under the lawn of St. Andrews Church, overflowed and covered the lawn and roadway to a depth of about two feet. The cellars of nearby residents were flooded . . .
>
> "From the surrounding country reports were coming in that water was overflowing many of the roads. . . . "
>
> (At Newburgh) "Mr. F. A. Breeze's dam at his mill was carried away by the water raising so high in the river. It was the highest for years and overflowed a long distance inland. A number of cellars were flooded with water a few feet deep."

At Enterprise, cellars were flooded; and the road from Enterprise to Moscow, through the Outlet Swamp, was under water. At various points, railway washouts delayed or prevented the passage of trains.

The floods of the 11th had not long subsided when a further heavy fall of rain, and the breaking up of the ice on the upper reaches of the river, resulted in a second flood, on March 19th. An ice jam on the west side of the swing bridge, at Centre Street, had to be broken up by dynamiting. Another serious ice jam threatened to destroy a 70-foot bridge over the Napanee River between Camden East and Yarker; a gang of men with axes, poles, and saws succeeded in loosening the jam and in saving the bridge. Again the road and railway through the Outlet Swamp were under two feet of water, and traffic was at a stand-still. Two raceways and part of "the old factory" at Yarker were carried away. At Yarker, also, "there was plenty of water in everybody's cellar."

The second flood was more than usually prolonged. The reports that made up the flood story in the Napanee Beaver of March 25, 1936, indicated the occurrence of high water almost continuously from the 20th to the 23rd; and on April 1st, the Beaver carried a dispatch from Yarker, dated March 30, stating that "the river reached its high mark this spring", which, it seems not unreasonable to suppose, may be a misprint for "this *morning*".

Since 1936, there is no record of any floods of noteworthy severity, on the Napanee River, or on any of its tributaries.

CHAPTER 3

HYDROLOGY

1. PRECIPITATION, STREAM FLOW AND RUN-OFF

(a) PRECIPITATION

There are no meteorological stations* on the Napanee Watershed but data available from stations adjacent to the area, with varied length of records, indicate an annual average precipitation of approximately 33.0 inches and an average daily mean temperature over the area of approximately 44° Fahrenheit.

The following table shows a summary of the recorded temperature and precipitation data for the adjacent stations.

Temperatures	Belleville	Kingston	Tweed
	Degrees Fahrenheit		
Average Daily Mean	44	44	43.5
Average Daily Min.	35	36	33
Average Daily Max.	53	52	54
Precipitation	Inches		
Average Annual	31.2	32.8	34.5
Average Annual Snowfall	61.9	62.4	68.1
Summer Rain	8.0	8.5	8.2

*One station equipped with a recording rainfall gauge and maximum and minimum thermometers has now been established at Bellrock.

(b) STREAMFLOW

Streamflow data for the Napanee Watershed are available from 1915 to 1926, and from 1946 to date. The original gauging station was established by the Ontario Hydro Electric Power Commission, but was later taken over and maintained by the Water Resources Branch of the Department of Northern Affairs and National Resources, Ottawa until 1926. In 1946 the station was re-established at the request of the Conservation Branch and continuous records have been kept since.

The gauging site is located at Mink's Bridge, 2 miles upstream from the town of Napanee. The original manually read staff gauge was replaced by an automatic continuous recording gauge in 1956. The drainage area above the gauge is 298.2 square miles. A second gauge was established at Bellrock in 1956 but the period of records is insufficient to be of value at this time.

(c) RUN-OFF

Run-off is that portion of precipitation that finds its way to natural or artificial channels, either as surface flow, or as subsurface flow resulting from infiltration and deep seepage.

The factors affecting run-off are numerous and varied and may be generally classified under two headings, (i) precipitation, and (ii) watershed characteristics.

Precipitation is the most significant since it is the source of all stream flow.

Watershed characteristics appear in so many combinations that it is difficult to classify or rank them in any order in relation to their direct effect on run-off.

The amount of run-off is of great concern to conservation, particularly to the flood control and low flow problems, and as the maximum and minimum values for run-off from an area form the basis for the design of all water control structures.

It is not the ordinary or average flows that determine the design, but the unusual or exceptional extremes of flow that may have occurred in the past or might reasonably be expected to occur in the future that must be used for design purposes.

2. MAXIMUM FLOWS

From the available records it appears that the maximum flows on the Napanee River do not approach the magnitude of those of other rivers of comparable size in Southern Ontario.

The maximum recorded mean daily flow over the period of 21 years was 3,400 c.f.s.*, or the equivalent of 11 c.s.m.† Increasing this by the use of Fuller's formula to an estimated momentary peak flow would give 4,630 c.f.s., or 15 c.s.m.

This is a relatively low rate of run-off for a watershed of this size, and it is obvious that the flood-producing characteristics are such that the probability of major flooding is kept to a minimum. From the flood occurrences as recorded and reported by newspapers and various independent bodies and outlined in

*Cubic feet per second.
†Cubic feet per second per square mile.

this report it might appear that flooding is a major problem on the watershed. However, it is most difficult, and at times impossible, to relate these floods to any hydrologic factors which may be expressed in sound quantitative terms.

Most of the occurrences referred to as flooding, were in the spring period, with an occasional above normal run-off in the summer and autumn seasons. In the period 1835 to the present only 21 floods have been recorded and the magnitude of many of these is doubtful.

3. LOW FLOWS

The average monthly mean discharges are lowest for the months of August, September and October. June and July show a fairly high monthly mean flow but there have been occasions when the daily minimum flows recorded have been as low as 8 c.f.s. during each month. Discharges as low as 1 c.f.s. have been recorded for the months of September and October, and 2 c.f.s. for August.

There is an obvious need for increasing the flow of the river, and particularly during the months of June to October inclusive.

If a storage area, or areas, for 11,850 acre feet were constructed above the outlet of Second Depot Lake, and the minimum recorded flows were used for both the replenishment and drawdown periods, a total theoretical flow of 63.8 c.f.s. could be maintained at Napanee during low run-off periods.

The main report indicates that sufficient run-off is available, even in the most critical years, to satisfy the demands for water which presently exist.

CHAPTER 4

THE LOW FLOW PROBLEM

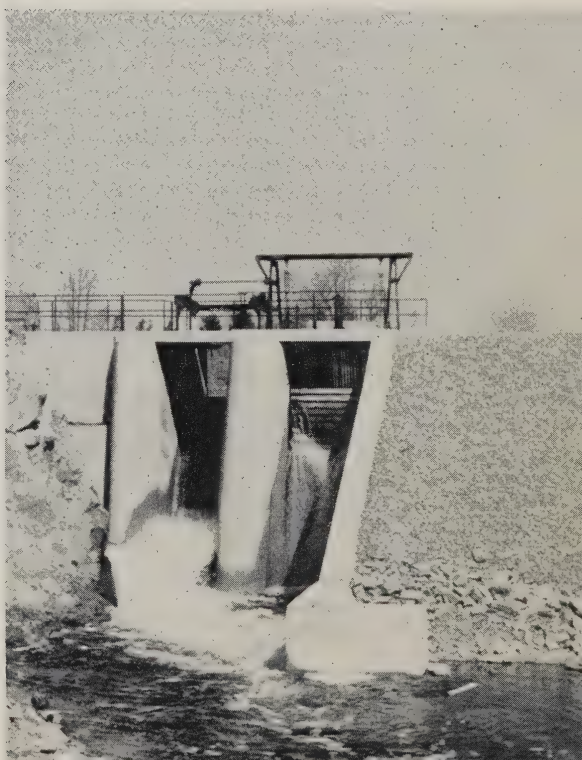
1. THE INCREASE IN FLOW REQUIRED

Any attempt to estimate the quantity of water needed in the Napanee River for increased summer flow is necessarily approximate. By far the largest single user of the stream is the town of Napanee which takes its domestic supply from the river, using water-driven pumps supplemented by electric motors when the stream flow is insufficient to drive the turbines. Some 35 c.f.s. is needed to operate the town's water-supply system and it is perhaps desirable to maintain 25 c.f.s. flowing over the falls at the Town Park both to aid the recreational possibilities of the park and to improve the quality of the water supply for the town by carrying floating debris past the waterworks intake. This flow of 60 c.f.s. is larger than any requirements existing at points higher up on the river and sufficient flow to satisfy this demand would satisfy other users.

A paper company uses the river for both water supply and sewage disposal and some difficulties exist at the Napanee Waterworks as a result of the ground paper and coal-oil from the paper company reaching the river.

The mills which are operated on the Napanee River are conventional grist and sawmills which operate on a run-of-the-river basis making use of the pondage which they control to generate power. In most cases there is insufficient water to permit operation during July, August and September. The owners of

General view of the earth and concrete dam at the outlet of Second Depot Lake. Dam raises the lake level 21 feet and provides 7,414 acre-feet of storage to augment the summer flow.



Close-up of spillway section showing sluiceways, stop-log hoists and gate headstand. Sluiceway on left is fitted with stop-logs while the right one is controlled by a four-foot diameter steel gate at the bottom and stop-logs in the upper part.

these mills form a Napanee River Improvement Company, which holds the water rights of the river by original charter. The problem of estimating the needs and benefits for these mills is difficult, but in any case their demand for water is less than that of the town of Napanee.

2. REPLENISHMENT AND DRAWDOWN PERIODS

It has been indicated in the preceding section that sustained flow at Napanee of not less than 60 c.f.s. is desirable. Normally there is a surplus flow in the river during the period from March to June inclusive, or 122 days, and flow from reservoir storage is required to augment the natural flow during the period July to February inclusive—243 days—to maintain the desired minimum flow of 60 c.f.s. at Napanee. The minimum *gross storage* required would be 7,282 acre feet.

The capacity of the Second Depot Lake reservoir is 7,414 acre feet which is about 62 per cent only of the water available for storage in the driest year known. Therefore with efficient operation of the dam there is ample storage to satisfy the *present* needs of the watershed. However with the ever-expanding demand for water, definite measures should be taken immediately to safeguard all available storage areas to ensure adequate water supplies for future needs.

3. RESERVOIR SITES AND MEANS WHEREBY THE STORAGE SHOWN HAS BEEN ESTIMATED

Although the entire basin of the Napanee River is dotted with lakes there are few sites which lend themselves to reservoir development. From the standpoint of loss through seepage and needs of the town of Napanee, storage in the Precambrian Shield is most desirable. Therefore it is fortunate that a number of satisfactory sites exist on the Depot River which at one time had numerous mill or logging dams. One mill at Bellrock is still active and the remains of many others are still in evidence. A cursory field examination was made of the sites and the drainage basins generally. The terrain is rough and undeveloped and the sites are only accessible by improved old lumber tote roads which are narrow single track, very crooked and hilly and not suitable for heavy motor vehicles.

A preliminary survey and plan has been made for the Second Depot Lake site and the storage is definite. That shown for the other lakes should be considered as an indication only. A line of levels will have to be run to determine the elevation of the lakes shown and the height of the dams possible at their outlets and contour plans prepared before a decision can be made for the next site to be developed. The areas of the lakes were planimetered from aerial photographs and these areas are sufficiently reliable for preliminary estimates. The depth of storage on the lakes and the water level profile, were developed by interpolation of the 25-foot contour intervals shown on the published topographical sheets. By this means the depth of storage could be in error by several feet, which would amount to considerable difference in storage capacity. It is obvious therefore that further preliminary surveys are necessary for the unsurveyed sites. In particular contour surveys will be necessary to cover the Third and Fourth Lakes. Dams could be built at the outlet of each lake but there is a possibility that one high dam at the outlet of the Third Lake would provide considerably greater storage at less cost provided that such a scheme would not interfere with the C.P.R. line which crosses the river between the two lakes.

4. CONSERVATION OF WATER

An adequate supply of good water is essential for the well-being, development and growth of the watershed. Its uses are many, namely: domestic, power, industry, dilution of pollution and irrigation. No matter how efficient sewage treatment plants may be their effluent has to be diluted by a considerable flow of good water to make it satisfactory for other purposes. Irrigation in very dry years requires up to ¼ of an acre foot or ⅛ c.f.s. for every acre of land irrigated. Little or none of this water is returned to the river, but is lost by evaporation and transportation. Should the Cameron Swamp be reclaimed for market gardening there would probably be a larger demand for water for irrigation which could be supplied from the Depot Lake system of reservoirs or, preferably, a reservoir at Mud Lake. Vast amounts of capital both Canadian and foreign are being invested in Canada and there is unprecedented development and prosperity. There is no reason why the Napanee Watershed should not share in it also. No one can visualize what the growth will be in, say, 25 years or even 10 years. It can be said, however, that it would be limited to the water supply. Water could be pumped from deep wells or the Bay of Quinte but the logical means of increasing the supply is by impounding some of the spring run-off which runs to waste. Therefore, good reservoir sites should be regarded as vital assets. There is no suggestion that dams should be built until they are needed but the reservoir sites should be purchased now while land values are low. Should any corporation become interested in any part of a reservoir site, land values would increase greatly.

If years later it was definitely known that the sites would never be needed they could be sold possibly with no loss in the investment.

All reservoir sites should be developed to at least average filling capacity, since any attempt to increase the height of a dam later would be impractical and an expensive undertaking.

5. MERITS OF THE RESERVOIR SITES

The storage in the First Depot Lake is too small for conservation and this site was eliminated.

A single concentration at the outlet of the Third Lake which would drown the Fourth Lake is proposed if feasible. The C.P.R. crosses in between these lakes and if a dam 25′ high would allow sufficient clearance under their bridge crossings about 13,500 acre feet of storage would be available. The total inflow for the lowest run-off period is only 11,016 acre feet, but for the average period is 22,386 acre feet. According to the records, there was only one year, namely the one shown, that the replenishment period run-off was less than 13,500 acre feet, so that an average drawdown discharge of 28 c.f.s. is almost assured.

The Fifth Lake is much larger than the other Depot Lakes and being near the headwaters has the best strategic location. It has a small drainage area however (17.1 sq. mi.) and the replenishment for the lowest period is only 4,957 acre feet which is equivalent to a depth of water above normal lake level of about 6′. The storage on this lake however should be developed at least for the average replenishment period, viz: 10,074 acre feet, or a depth of water of

12 feet and storage built up and held in reserve for lean years. For the same reason with a survey of the site and further study, a reservoir which would hold the run-off for the maximum replenishment period run-off, namely, 16,524 acre feet or a depth about 20 feet, might be considered. Such a dam would be a long one but the spillway capacity would be only a fraction of the other sites, and large increase in storage could justify the extra cost.

In either case with a depth of storage of 12 or 20 feet, the built-up reserve could be used, if desired, to regulate the levels of the reservoirs downstream should it be desirable to operate these within close limits.

As stated previously, there will be sufficient storage in the Second Depot reservoir for the present. Therefore storage on the other sites is for future consideration when demands for water will be better known.

CHAPTER 5

SECOND DEPOT LAKE DAM AND RESERVOIR

Second Depot Lake, as its name implies, is the second of a series of lakes on the Depot River. It fills a comparatively steep-walled depression in the Precambrian rock of the Canadian Shield and has a surface area of 256 acres. The total drainage area of 49.2 square miles above the proposed damsite would need a surface run-off of less than 3 inches to fill the storage capacity of 7,414 acre feet.

The dam is located at the outlet of the lake in Lot 4, Con. VIII, Twp. of Hinchinbrooke and consists of an earth fill structure, with concrete spillway and control section, 185 feet in total length and with a height above low water of 25 feet. Protection against seepage is ensured by an impervious core, keyed to the bedrock, with steel sheetpiling in the central portion. The earth embankment has a crest width of 12 feet, freeboard of 5 feet, with upstream slopes of 1 in 2½ and downstream of 1 in 2. Both slopes are protected by riprap with toe drains of 4-inch tile in rockfill.

The concrete control structure, located at the west end of the dam, is dowelled into the solid bedrock. It consists of a 4-foot diameter discharge tube with invert at elevation 99.5* controlled by a manually operated sliding sluice gate. The discharge tube, under full head has a maximum flow of 320 c.f.s. The stop log section with a width of 8 feet and a depth of 15 feet will discharge another 1,400 c.f.s. and additional stop logs above the sluice gate down to elevation 114 provide a further spillway capacity of 400 c.f.s., or with all outlets open, a total discharge capacity of 2,120 c.f.s. is provided.

The reservoir is crossed by a transmission line of the Hydro Electric Power Commission but no towers are affected by the flowage.

The roads lying in the reservoir are second-class township roads, and only short lengths are affected. Re-grading over a length of 575 feet and construction of 2,450 feet of new road was necessary.

*All elevations are referred to an assumed datum of 100.0 for low water elevation at the lake outlet.


WILDLIFE

CHAPTER 1

INTRODUCTION

Adequate planning for wildlife in Southern Ontario is very important. The hunter and fisherman regard the opportunity of seeking game and fish with a reasonable chance of success as healthy pursuits of the highest order. The money derived by the fur trapper from the sale of furs is also an important item of income. The increasing numbers of naturalists, photographers and other private citizens who enjoy a drive through the countryside derive great satisfaction and pleasure from seeing the varied forms of wildlife in attractive environments.

With careful handling of the places in which the various kinds of wildlife live and by managing their numbers, wildlife populations should have no adverse effect on most good land use practices. Indeed, the best farm husbandry, the best land management and the best methods of handling woodlands normally go hand in hand with good wildlife conditions. Thus the control of undesirable or harmful species of animals, while the more desirable or less harmful ones are maintained by habitat manipulation, hunting, fishing, trapping and other sound wildlife management techniques, becomes an essential branch of good land management.

The present report, based on a short-term examination, deals with a few specific problems in this watershed and a single problem, improving the farm for wildlife, which is of much more general application.

The Napanee Watershed appears to have four major types of land and water from the point of view of wildlife. The whole of the north and north-eastern section consists of woodland and scrubland (much burned and in part over-grazed and also eroded to bedrock in many places) and about thirty lakes and a great many small ponds. Many of the lakes contain excellent fishing. The land consists of many low, rounded hills surrounded by marshes. The second land type is the 8,000 acres of the Cameron Swamp, which is very poorly drained. The more southern part of the watershed consists chiefly of shallow-soiled land over limestone, which is partly cultivated or pastured. Lastly there is the valley of the Napanee River itself. This is a fertile area of debris filling a wide cut in the limestone itself. The present river is of course much smaller than the former one, and now falls about 200 feet from the vicinity of the Cameron Swamp down to Napanee. Most of the settlements along this part of the river's course are naturally to be found where the larger falls or rapids occur, since these supplied a head of water for power and an impounded reserve for use in any other plant operation.

The specific subjects discussed in this report are: the value of the Cameron Swamp for wildlife; data concerning eight of the lakes; the suitability of the river for fish; and the pollution of the river above Napanee in 1956.

CHAPTER 2

THE WILDLIFE OF THE CAMERON SWAMP

A general summary is made here of the present significance of the swamp for wildlife. The chief source of the following information was the District Biologist of the Department of Lands and Forests at Tweed.

WHITE-TAILED DEER

The area known as the Cameron Swamp is not considered important as a deer-hunting area.

The chief reason for the absence of deer as a permanent population in the Cameron Swamp is the high water level and flooding of the swamp which takes place during any rainy autumn season. In winter the swamp is still flooded and freezes over. This is hardly a suitable habitat for wintering deer since most of the tree growth in the swamp is tag alders, soft maple, black ash and elm. The swamp does not usually dry up until June, and at this time deer in the surrounding area may migrate into the swamp. In those seasons when the swamp does dry up early, some does give birth to their fawns on the higher, dry areas of this region, so there is a small population remaining in the swamp during the summer. Virtually no deer are shot during the open season in the swamp.

RED FOX

Foxes appeared to be plentiful in the low-lying areas of the swamp in the winter of 1956-57, and many tracks could be seen on the snow-covered ice surface of the swamp when it was visited by the District Biologist. Farmers in the area say that the edges of the swamp have become a haven for foxes, which go out to the surrounding farms and prey upon their poultry.

BEAVER

Beaver are not common to this area, but a few pelts are taken by trappers annually. The general lack of poplar in the swamp may be the reason for their scarcity.

MUSKRAT

Muskrats are found in fair numbers along the course of Cameron Creek, which flows through the central area of the swamp, but in its present condition the swamp is not an important muskrat-producing area. The fluctuating water levels are no doubt the chief reason for this condition. The large wooded areas of the swamp of course do not contain ample supplies of cattails, sweet flag, or other useful muskrat foods.

BRUSH WOLVES

Some brush wolves are known to inhabit the general area of the swamp and are occasionally seen along the perimeter.

RACCOON

Raccoons are common in the swamp, but very little trapping for them is carried on. However, the farmers occasionally hunt them with dogs for sport.

MINK

Mink are taken at intervals along the river courses by trappers, but they are not considered plentiful.

OTTER

One otter slide was noted deep in the swamp on the bank of Cameron Creek early in 1957. However, trappers state that otters are scarce.

WATERFOWL

Some black ducks nest in the Cameron Swamp along the river edges and at the edge of Pond Lily Lake and Napanee Lake. But these areas do not provide very important nesting grounds. Wood ducks, which nest in trees, are fairly numerous in the swamp.

Duck hunting is said to be reasonably good in some parts of the 8,000 acres of the whole swamp. Wild rice grows in the shore areas of Napanee Lake, Pond Lily Lake and Lost Channel, but there is no wild rice in the great general region of the swamp itself.

UPLAND GAME BIRDS

RUFFED GROUSE

Ruffed grouse appeared to be the only species of upland game bird found in the Cameron Swamp. These birds occupy the islands within the swamp, and they are hunted to some extent during the open season. Some of them spend the winter in the swamp.

BULL FROGS

Bull frogs were said to be plentiful in the swamp in former years, but later the population fell to a low level. They appear now to be on the increase. In previous years they were sought after by various people on a rather large scale, and this may have contributed to their decline.

SMALL MAMMALS

Since the water level in the swamp is always very high in spring, there can be no very large population of terrestrial small mammals in the swamp. The swamp does not appear to be good habitat for shrews, moles, deer mice, meadow mice or jumping mice except on a few of the higher islands in the swamp.

BIRDS

It is probable that about 280 species of birds live in or migrate through the watershed, but only about 120 species remain during the summer to nest in the watershed. One hundred and fifteen species of birds were observed as resident in the nearby Moira Watershed in the summer of 1948 by the Department of Planning and Development's survey party. Of these probably 60 or 70 species might be found within the area of the Cameron Swamp in summer. No attempt was made to make an adequate list on the Napanee survey.

Summarizing the above information, it does not appear that the present wildlife in the Cameron Swamp has any great monetary value. An increase in the number of drainage ditches would probably increase the population of muskrats considerably. The most useful conclusion is this, that before any major change in the land use of this area is planned or considered, a careful appraisal of the present or potential crop of sawlogs, fuelwood and fish and wildlife should be made, which would accompany an investigation of the swamp's ability to increase or decrease the flow of the Napanee River.

Naturally the Cameron Swamp is a most useful storage basin for delaying the spring run-off into the upper Napanee River and for reducing excessive flows after heavy rains. Also it benefits fish by keeping a more equable flow in the river in these periods.

CHAPTER 3

IMPROVING THE LAND FOR WILDLIFE

The many varied types of land in the Napanee Watershed have already been mentioned. The requirements of food and cover vary greatly for different species of wildlife. The recommendations listed here are therefore those which can be most generally applied by the landowner.

1. WOODLANDS

The elimination of grazing of woodlots would be the most useful single measure in improving the wildlife environment. In plantations, up to about the tenth year from planting, the entire planted area is valuable for wildlife. But large blocks of coniferous trees will, at least after about the twelfth year from planting, have little or no undergrowth and will, apart from their edges, be comparatively sterile as far as upland game and most forms of wildlife are concerned. The chief improvements to be expected will therefore come from good management of the farm woodlot. Selective cutting is both sound forestry practice and good planning for wildlife. Landowners who have woodlots in which the crown canopy has closed over considerable areas and who wish to produce a proper environment for wildlife will find that release cuttings, slashings to stimulate sprout growth, thinnings and felling timber for sale will improve rather than retard the carrying capacity for wildlife. Construction of brush piles from cuttings is recommended where rabbits are desired, two or three such brush piles per acre being the normal spacing.

2. CULTIVATION PRACTICES

All good farming practices which make a more luxuriant vegetation will improve the farm environment for wildlife. A few special practices will give more specific benefits. Strip-cropping, described elsewhere in this report, is of particular value, since by this means no extensive area is denuded of cover at one time by harvesting. In the less flat parts of the agricultural section of the watershed filter strips, either above water diversion terraces or used as emergency waterways, provide travel lanes and nesting cover for wildlife. Cover crops such as the clovers provide a habitat and food for wildlife in areas that would otherwise be barren during the winter months.

The elimination of brushy fencerows is now becoming more common in the Napanee Watershed. Those who are interested in wildlife improvement will find that the inclusion of a few field boundary hedges on the farm will moderate the effect of winds on crops, serve as travel lanes and cover for wildlife and harbour large numbers of songbirds which help to control insect pests. Inevitably the presence of boundary hedges on a farm tends to encourage the growth of weeds. This is the price that must be paid for improved wildlife conditions. *Rosa multi-*

flora is an excellent hedge-forming shrub. It has a tendency, in Southern Ontario, to die back in winter but rapidly forms a dense hedge, which is reported to be proof against cattle and hogs. It provides both cover and food and does not exhaust the nearby cultivated ground. However, in view of its questionable hardiness it should be planted sparingly in the Napanee Watershed.

The following are a few species of plants which are of particular value as food for wildlife. Those marked with a star (*) can usually be found growing on some part of every farm.

**Wild Grape*—This plant provides excellent wildlife food and cover, but it forms such a dense tangle over fences and young trees that it should only be planted where it can be carefully watched and controlled.

Hairy Vetch—This plant can be grown on poor, sandy soil. Cottontails and the European Hare use it for food and cover. The seeds are eaten by a great many of the ground-feeding birds.

European Millet—This plant fruits profusely and the seed attracts vast numbers of birds. It is grown commercially for bird seed.

**Elderberry*—A great many species of birds feed on the small black juicy berries, and there are not often many of the fruits left in winter. However the birds, once attracted, will return to feed on other fruits.

Mountain Ash—Mountain Ash is both a very attractive tree in appearance and also a most useful tree for its scarlet fruit.

Corn—A few rows of uncut corn standing in a field or garden will provide excellent cover and a continual supply of food for the larger birds, including the Ring-necked Pheasant and the Hungarian Partridge. Cracked corn is useful for smaller birds. Corn left near streams will almost certainly be destroyed and the cobs eaten by raccoons. At present there are probably no Hungarian Partridges in the watershed, although they thrive both east and west of it in various parts of Ontario. The Authority might urge an experimental introduction of the species, when the present population near Winchester, Ontario, reaches a high level.

There are many other plants that could be recommended for use as cover, food or nesting sites. The best general reference book on this subject, for birds of the Napanee Watershed, is "Planting Your Garden for Wild Birds" by James R. Mackintosh, published by the Audubon Society of Canada, 181 Jarvis Street, Toronto, Ontario.

3. FIELD CORNERS

Field corners are frequently barren of crops. Therefore a fence crossing which embraces the corners of four fields may be made into a haven for ground-nesting species by planting a few trees and shrubs and protecting them. It is important to rid such areas of useless weeds by crowding them out with useful species such as white sweet clover or the normal climax type of open vegetation, which is bluegrass.

An attractive stretch of the Depot River half a mile north of Bellrock. The flow of this river will be increased in summer by the planned Second Depot Lake Dam.

Debris is dumped by a roadside in spite of signs prohibiting this practice. The smell is extremely offensive. This "dump" is 1½ miles south-west of Carmanville.

4. PONDS AND STREAMS

The importance of water to wildlife is often forgotten. Many farms have at least one low spot where a small amount of work with a scoop will create a dam and a pond to provide nesting and feeding sites for water and marsh birds. If possible, ponds for wildlife should be separate from those intended for cattle or for fish. Willow cuttings pushed in the ground around such a hollow will rapidly provide wildlife cover. New water areas are usually very rapidly invaded by aquatic plants, but additional species may have to be introduced. No extensive duck food studies have been made in Southern Ontario. Wild rice may be introduced, but since it is not well adapted to wide variations in water levels during its growing season, being often sterile in fluctuating waters, it cannot be considered as certain to succeed. The seed must be kept wet from the time it is harvested until it is sown (or broadcast) on the water surface. The idea has long been current, and fostered by many sportsmen's organizations, that the growing of wild rice is the answer to the problem of how to attract ducks to any area. The fact is that wild rice is of little significance to ducks in Canada except in the fall, and does not provide good cover or nesting sites.

The following species, which may be easily obtained, are recommended as certain to be valuable duck foods. If none of them occur in ponds or shallows with good cover for ducks, they can be introduced. All of them are hardy in Southern Ontario.

Sago Pondweed	*Potamogeton pectinatus L.*
Red-Head Pondweed	*Potamogeton Richardsonii (Ar. Benn.) Rydb.*
Wild Millet	*Echinochloa crusgalli (L) Beauv.*
Japanese Millet	*Echinochloa frumentacea (Roxb) Link*
Wild Celery	*Vallisneria americana Michx.*
Knotweed	*Polygonum pensylvanicum L.*
Water-Smartweed	*Polygonum coccineum Muhl.*
Three-square	*Scirpus americanus Pers.*
Great Bulrush	*Scirpus validus Vahl., var. creber Fern.*
Duckweed	*Spirodela sp. and Lemna sp.*

Those who are interested in farm ponds for wildlife will find very useful details of the various types of pond and methods for constructing each type in a booklet, "Farm Ponds", which is available from the Department of Agriculture. Farm ponds differ from those intended for wildlife in that care is usually taken to prevent the growth of aquatic vegetation in a farm pond intended only for watering stock or fire protection purposes. Otherwise, the construction and details of ponds for wildlife should follow one of the types there described.

Algae in ponds are often only present for a short time and will disappear in a month or so. A concentration of .5 p.p.m. of copper sulphate will destroy them temporarily at least. The larger aquatic vegetation, if too abundant, cannot be removed except by cutting (a heavy chain is useful), by draining the pond or by the use of 2,4-D for emergent vegetation or poisonous compounds such as sodium arsenite for submerged plants. These compounds will of course kill fish also, and

the use of this method requires permission from the Department of Lands and Forests and the Ontario Water Resources Commission if the treated water flows into any other privately owned or public waters.

CHAPTER 4

FISH

1. INTRODUCTION

The purpose of this survey was to classify the waters of the Napanee drainage basin as to their present suitability for fish and to make recommendations for improvements with examples in detail.

2. METHODS

It was felt that for fish management of the 20 lakes the primary necessity would be to map the contours and temperatures of those lakes which could be reached easily, so that the depth and volume of each lake could be determined. This procedure was carried out for eight of the larger and more accessible lakes. This work took up much of the time of the survey. Gill nets and small seines were also used to acquire some information on the species present in each lake but this was by no means complete. No attempt was made to make quantitative estimates of the fish populations.

The 35 stations on the Napanee River and its major tributaries were from half-a-mile to three miles apart on each stream course. The topographic features of the valley and the erosion, vegetation, volume of flow, turbidity, temperature and type of bottom were listed for each station. At all suitable stations collections of the aquatic insects and other invertebrates were made. At most of the stations collections of fish were also made, and these collections were later examined and classified and were used in zoning the various sections of the river.

Many aquatic insects such as mayflies, stoneflies and caddisflies are reliable indicators of the stream conditions at the critical time of year. Some are confined to waters which remain cold and clear in summer, such as trout waters. Others are indicators of permanent flow or of polluted water or of the maximum summer temperature of the water. Thus the potentialities of a stream for particular species of fish are indicated. Fish collections and records of maximum-minimum thermometers substantiated these findings at their particular stations. Since the procedure here used follows that of other river surveys, it allows close comparisons of the characteristics of many rivers. The present criteria and methods were developed from more intensive year-round research carried out by Dr. F. P. Ide of the Department of Zoology, University of Toronto, in many parts of Ontario. Since many of the streams were examined only once, it was necessary to rely chiefly on deductions made from the presence or absence of species known to be reliable indicators.

3. PERMANENCE OF FLOW

One might conclude from a rapid examination of a map of the watershed, with the many lakes lying in the courses of the various tributaries, that the flow of the main stream would show relatively little fluctuation, but this is not the

A view showing the vegetation in the centre of Varty Lake. The lake is nowhere more than six feet deep.

Cameron Creek, seen from the road south of Bellrock.

case. It is clear that any storage effect caused by the presence of the many lakes in the river and its tributaries is offset by the evaporation effects during the summer. The fact that there are no lakes in the course of the main stream below Petworth in Portland Township, and the great areas having very shallow soil over bedrock in the northern part of the watershed, seem to be the critical factors affecting the river flow in summer. The effect of the Cameron Swamp on the river's flow has not been determined. Whatever the various causes and effects may be, the net result as shown by measurements at the Napanee gauge two miles above the town of Napanee is that there is commonly a period of very low flow in late summer.

The biological examination of the river was made in May and June, 1950, and early in 1956. The difficulty of classifying the types of stream from examination in June may be gauged from the following table, which shows the daily mean flows at the Napanee gauge on various dates in the month of June in 1950 and 1956. During the course of the survey the flow at Napanee varied from 99 c.f.s. to 850 c.f.s. At the same gauge flows as low as 1 c.f.s. have been recorded on 15 days during various years since 1920, and there have of course been many periods in late summer when the flow was less than 10 c.f.s.

DAILY MEAN FLOWS AT VARIOUS DATES IN JUNE 1950 AND 1956

NAPANEE GAUGE

	June 1	June 5	June 10	June 15	June 20
1950	131	145	164	131	99
1956	686	858	675	440	280

On the map accompanying the main report the permanence of flow is shown, so far as it could be deduced from the presence or absence of fish and indicator species, and from local reports. However, many of the smaller streams are marked as "Not examined".

4. TEMPERATURE CONDITIONS

The summer temperature conditions which can be expected to affect the distribution of fish in most years are also shown on the accompanying map. Of all those streams examined only a single one was found to be good brook trout water. Adult brook trout should thrive best in the lower part of the section lettered COLD. Usually separate sections with intermediate temperatures, to which brown trout can adapt themselves, are shown on these maps, but no water of this type was noted during the present survey.

Almost all of the streams appeared to consist of the overflow from lakes or marshes, and accordingly all of the water examined, apart from the one trout stream noted, is classified as warm (with maximum over 75°F. in summer) and suitable only for rock bass, smallmouth bass and associates.

5. FISH DISTRIBUTION

Thirty-six species of fish were collected in the waters of the Napanee Watershed during the survey. Three species were found *only* in the lakes. The remainder were found in the rivers or in both rivers and lakes.

Further collecting or angling would of course increase the known range of some of the species, and there must also be several additional species present.

The one trout stream examined had many young trout in it in 1956. One 14-inch trout was collected and returned.

The excessive flow in the streams during the surveys made the collection of fish a difficult process, and probably accounted for the fact that some species which are certainly common were actually collected at few stations. Creek chub, for instance, were collected at only 3 stations, and carp at none. The longnose gar and the alewife were found at Napanee only. The species which appeared most commonly in the collections were the bluegill and the bluntnose minnow (at 18 stations each), the pumpkinseed (at 13 stations), the common shiner (at 14 stations), the brown bullhead and yellow perch (at 10 stations each). So far as the streams are concerned, largemouth bass were found only at 1 station and smallmouth bass at 4. Two small fry of the burbot were found in a part of the river at the east end of the Cameron Swamp. The nearest deep lakes from which the adults may have moved to spawn are Howes Lake and Silver Lake.

The fifteen fish species of interest to anglers and the lakes in which they were collected are:

Varty Lake
White sucker, yellow bullhead, northern pike, yellow perch, largemouth bass, rock bass.

First Depot Lake
Brown bullhead, northern pike, rock bass, bluegill, pumpkinseed.

Second Depot Lake
Shallow-water cisco, white sucker, northern pike, yellow perch, rock bass, bluegill, pumpkinseed.

Fourth Depot Lake
White sucker, brown bullhead, northern pike, yellow perch, yellow walleye, rock bass, bluegill, pumpkinseed.

Howes Lake
Brown trout, yellow bullhead, brown bullhead, northern pike, yellow perch, yellow walleye, largemouth bass, smallmouth bass, rock bass, bluegill, pumpkinseed.

Thirteen Island Lake
White sucker, brown bullhead, northern pike, yellow perch, largemouth bass, smallmouth bass, rock bass, bluegill, pumpkinseed.

Silver Lake
White sucker, yellow bullhead, northern pike, largemouth bass, rock bass, bluegill, pumpkinseed.

White Lake

Shallow-water cisco, white sucker, yellow bullhead, brown bullhead, yellow perch, largemouth bass, smallmouth bass, rock bass, burbot.

Apart from Mud Lake and Varty Lake, both of which are very shallow and lie south of the edge of the Precambrian Shield, and perhaps Fourth Depot Lake, any of the species *may* be present in any of the lakes examined. Brown trout were caught only in Howes Lake during the survey. Below Strathcona very few live fish were encountered.

6. POLLUTION AND FISH LIFE

There are several points at which the Napanee River is polluted—by debris from grist mills, by septic organic wastes and by the deposition of sawdust, which tends to render the river bottom sterile and to reduce the bottom fauna; but none of these effects was found to be of much importance compared with the pollution from Strathcona.

There are two chief problems caused by the mill effluent. One is oxygen depletion, which is almost inevitable with the effluent of a paper-making plant when most of the stream is used for operating the plant. Much of the material used is old paper. The second problem is phenol control. Since tests have repeatedly shown the presence of phenol, and there is apparently no phenol used in the plant operations, it is considered probable that phenol is liberated from certain of the glues in the old papers, notably those containing resorcynol, a benzene derivative, like phenol. Phenol affects the river both in giving the water a carbolic taste and also in giving a phenolic flavour detectable in fish which have been forced to live in water that has more than a trace of phenol in it. The effects of the phenol and the shortage of oxygen were noted in the river well below Napanee. The following concentrations in parts per million of phenol have been reported to be lethal or damaging to fish: trout 9-10, perch 12, minnows 17. According to Niegowski the biologically safe concentration of phenol with respect to mayfly larvae (a useful fish food) is reported as 2.7 p.p.m. Concentrations as high as 18 p.p.m. of what appeared from the indicator reagents to be phenol have been recorded in the river below the mill. For the prevention of tastes in water it has been recommended that phenol concentrations should not exceed 0.002 p.p.m. after initial dilution in streams.

Since it is well established that in periods of low flow virtually the whole of the water of the river passes through the mill, it was considered a useful procedure to carry out a test of the effect of the effluent on the fish of the river, for comparison with conditions after the planned Second Depot Lake Dam is in operation. For this purpose a simplified type of a test originally made by Doudoroff was used. Because the river was at a high flow when the tests were made, samples of the actual effluent were taken and diluted with river water from above the mill in four different concentrations. Fish of two species common in the river above the mill were used in the tests. These were the pumpkinseed (*Lepomis gibbosus*) and the bluntnose minnow (*Hyborhynchus notatus*). It was not found possible to pass a stream of water past the fish and they were therefore tested in tanks. It is of course possible that there may have been oxygen deficiencies in the experimental aquaria greater than those in the stream itself. Care

was therefore taken to use amounts of water much greater than those which usually are considered necessary for survival of the fish used and to renew the supply regularly. Thirty-five minnows and 15 "pumpkinseeds" were used in these tests. Water temperatures were kept at approximately the temperatures of the river.

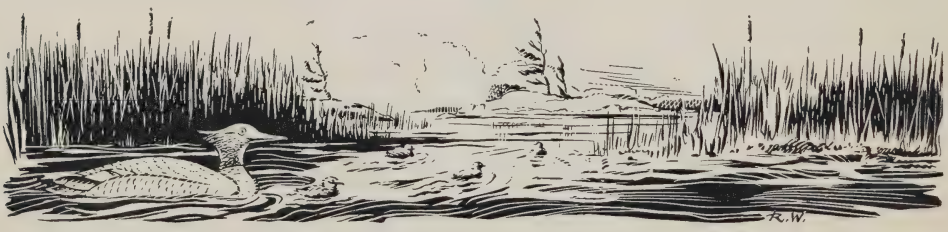
The median tolerance limit, i.e. the concentration which is lethal to 50 per cent of the test animals, was found to be close to a concentration of 25 per cent effluent for both species. It was found necessary to discontinue the tests on most of the fish after 96 hours, although the wastes might have had later effects on some of the surviving fish.

It was certainly evident that these fish could not live in the summer low flow below the effluent.

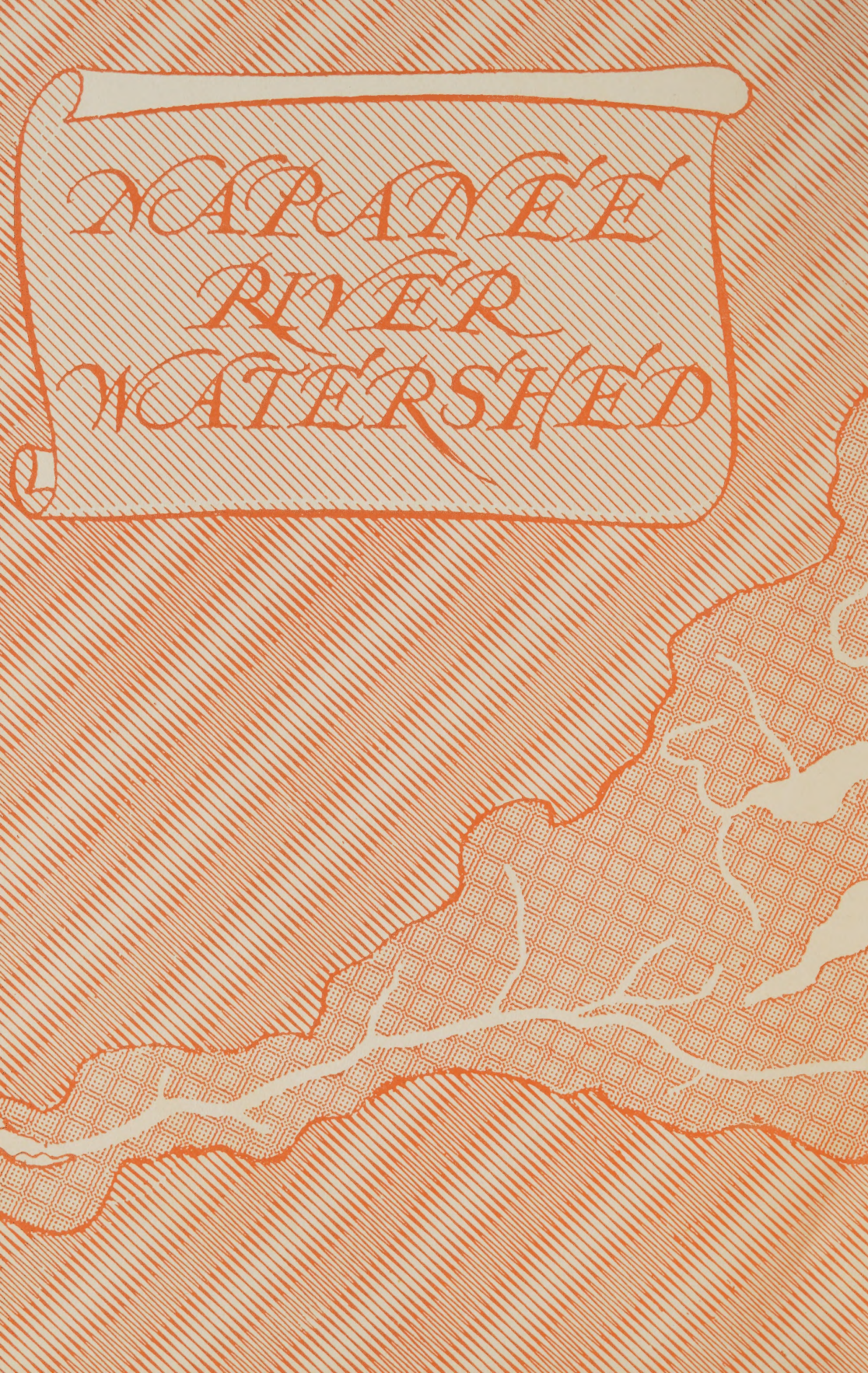
Five concentrations of effluent were used, namely, 100, 75, 50, 25 and 0 per cent. In the 100 per cent solution three fish died immediately, five survived 12 hours and two survived 24 hours. In the 75 per cent solution four died immediately and six died within 12 hours. In the 50 per cent solution four survived 12 hours, five survived 24 hours and one 36 hours. In the 25 per cent solution two lasted 36 hours, two sixty hours and six to the end of the test.

It is admitted that the sample is extremely small (50 fish), and the method of test is open to some criticism. There is, however, no doubt of a regular trend towards increased lethal effect with increasing concentrations of the wastes.

It is entirely probable that the concentrations of toxic compounds are much greater than those which were found in the samples of the effluent tested, when an occasional poisonous slug is admitted to the river. Investigations being carried out by Doudoroff and others tend to show that the bottom fauna, which are used by fish as food, are affected by even lesser concentrations of paper mill wastes than are the fish themselves. For any hope of satisfactory fish life in the river it is therefore essential that the wastes be very efficiently treated and that virtually no phenol be allowed into the river.



NAPA-SONOMA RIVER WATERSHED



Conservation

with its abundance of

good things is rooted

in the future.

Samuel Woodstock